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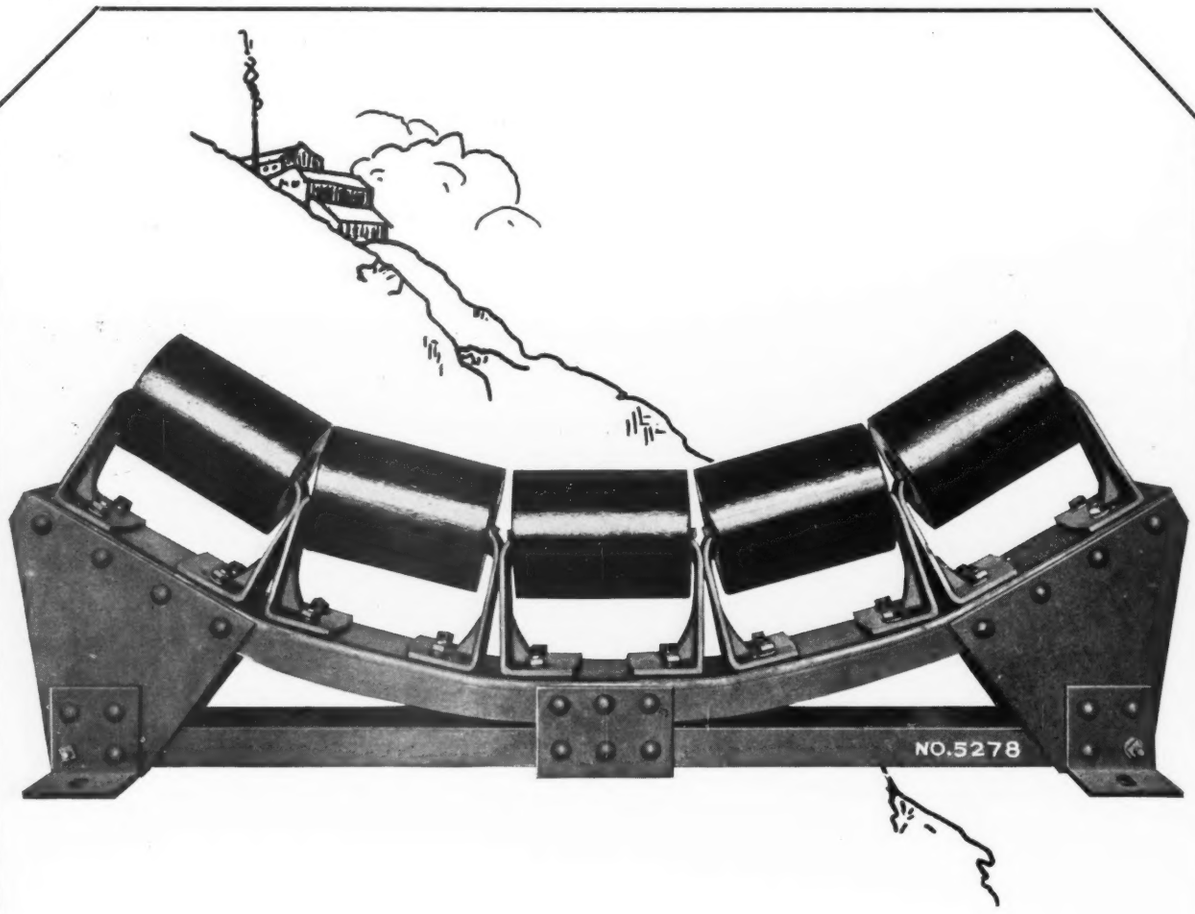
Setting Diamonds in Drill Bits, by George J. Young

A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

March 31, 1923



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ENGINEERING & MINING
JOURNAL-PRESS
J. E. SPURR, Editor

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The War Against Individualism

IT IS NOTEWORTHY that at the period when people like Herbert Hoover and Julius H. Barnes are writing of the glories of American individualism, the American people are drifting into a condition which tends to diminish individualism; and the instruments which promise to discipline the individual to the point of humility and colorlessness are the federal and state governments, the societies and all the other organizations which put mass action above individual initiative.

A strong note of protest came some time ago from President Nicholas Murray Butler of Columbia University. He pointed out that the American people are being surrounded by rules of "thou shalt" and "thou shalt not" which rival the best Prussian days of "erlaubt" and "verboten"; that an army of uniformed officials and un-uniformed spies are kept to pry into the private life of citizens, to see whether or not they take, as St. Paul advised, "a little wine for the stomach's sake." He pointed out the growing authority and insolence of tax-collectors and the police; and further called attention to the fact that this endeavor to regimentalize the country was breeding a counter spirit of revolt and an unprecedented record of crime. So much for Columbia. Now comes President Ferrand of Cornell, who in a recent speech called attention to the restrictive legislation now being proposed to interfere with individual freedom and human liberty. When the presidents of great universities, who have proved themselves expert in the matter of necessary discipline, protest that the American is being forbidden the development of individualism, the country should sit up and take notice.

Dr. Ferrand called attention to the fact that in Oklahoma they were discussing the passing of a law to prevent the teaching of evolution in the schools; that in Oregon a bill had been passed forbidding the sending of a child of compulsory school age to private schools; and that in Iowa the legislators were engaged upon a law fixing the length of hotel bed sheets.

Senator Borah, in a recent speech, touched upon the same problem, and referred to the scores of men who are now in jail for having consistently opposed war at the period of the World War. Senator Borah points out that some of these men are serving long sentences for a "crime" that is not on the statute books—that of belonging to the I. W. W.—and rightly points out that a country which keeps citizens in prison for years, for a misdemeanor which the law has not defined, has abandoned the strict adherence to the recognition of individual rights.

The country is alive with minorities who strive to curb the individualism of the majorities, and who succeed: and the legally qualified majorities, in their turn, have little sensitiveness regarding the rights of those whom they outnumber. This is the age of hushers and shushers. Anything you say or do is going to displease somebody who is influential, or some portentous group: so keep mum, and accumulate money. Honesty is the most reckless policy. Pussyfoot around, avoid treading on the corns of anything that has a kick in it; and eventually you may winter at Palm Beach. This is the state of mind that gives the freak legislators, the prejudiced and narrow minded, a chance to curb initiative, individuality, and liberty. We have been told that a former candidate for United States Senator in Utah has been arrested for smoking in public in Salt Lake City. So much for the Mormons. Says the *New York Times*, apropos of this problem, "Restrictive legislation carried to the extreme makes a race of Robots"—Robots, it will be remembered, being the mechanical race of pseudo-human beings pictured in Capek's play of "R. U. R."

State Mining Bureaus

THE MOTIVE for state mining bureaus is, as far as ascertainable, the promotion of the mining industry. Unlike state geological surveys, their task is vague. Their support by state taxation is uncertain. Their weakness lies both in leadership and in inability to secure an able personnel. They are apt to become appendages to state political machines and as such represent a waste of the taxpayers' money.

Nevertheless, under able leadership they can become of service to the mining industry. The mistake that is customarily made by such bureaus is the attempt at building up an elaborate organization. At best, the organization should be simple. The leader should be a well-trained and experienced economic geologist. Apart from clerical assistance, which is essential, any work of an investigative nature should be planned beforehand and an appropriation made from a fund established for the purpose. The work should be done in collaboration with the U. S. Geological Survey, and the Survey should approve the selection of the man who is to do the work.

Reports prepared and published under such auspices would be authoritative and of value. The publication program would be restricted, but the money would be efficiently spent. The subjects of most interest are the raw mineral products consumed by industries. The work done should be in the nature of investigation of the sources, the geologic conditions, and such economic data as pertain to markets and specifications that the mineral in question must comply with to be marketable.

Statistics of mineral production are gathered and published by the U. S. Geological Survey. Duplication of this statistical work by state agencies is an unnecessary expense. The work of areal and structural geology is in the hands of the U. S. Geological Survey. Unless the state has specifically appropriated moneys for this purpose, and such work is to be done under standards comparable with the work of the Survey,

it should not be attempted by the local bureau. The preparation and publication of bulletins should be restricted to first-class material authorized by competent men, not by tyros or young scouts in the pin-feather age. This can be done by paying a reasonable compensation to experienced men. The plan obviates the necessity of maintaining a larger organization and the embarrassing task of keeping such an organization busy. The net result of such a condition is mediocre work, unsatisfactory to all.

As a case in point, the California State Mining Bureau expended in the biennium ended June 30, 1922, $437,247 for its activities. Part of this, $296,375, was expended by the Department of Oil and Gas for the prevention of water infiltration in oil-bearing formations and the regulation of oil-well drilling. This expense is directly carried by the petroleum industry of the state. The balance, $140,872, went to so-called promotion of the mineral industries and was derived from taxes. The bureau maintains a museum, a library, and a miscellaneous staff. It published two monthly bulletins, one on the activities of the Department of Oil and Gas, doubtless paid for by the petroleum producers, and the other, a general bulletin. It maintains a statistical department and publishes various bulletins from time to time. Many letters are received and answered. It is an excellent example of a loose, well-intentioned, but poorly managed organization. Noteworthy work could be done for the expense incurred; but the publications leave much to be desired. At times it has been a political football, although the political stigma has been diminished of late years. California produces a never-failing crop of ubiquitous politicians who have a happy hunting ground among a virile and prosperous people. These politicians have been loath to surrender any of their perquisites and are largely responsible for the fact that California has failed to establish a mining bureau that has achieved more than a halfway point in its endeavors to serve the mining industry of the state.

Radio in the Mining Camp

A PICTURESQUE ACCOUNT of the annihilation of distance between an isolated mining camp and a center of industrial and social activity, thousands of miles apart, is given in a recent issue of the Los Angeles *Times*, which broadcasts what is generally admitted to be the best radio program on the Pacific Coast. Unfortunately for the Alaskans, "KHJ," as the sending station is designated, can be picked up only at night in the Far North. However, this involves no hardship for the miner, who is a busy man in the hours of daylight.

The account portrays the excitement occasioned by the advent of the first long-distance receiving apparatus. "This is to be the night of nights," the account reads. "Lafe Judson's radio set has been completed, and up and down the creek the word has gone forth that it is to be tuned in. The sourdoughs arrive from all directions. The little cabin is crowded to suffocation. Everyone is listening intently for the first sound. And then—

"Over the icy palisades from the balmy Southland into the little room is borne a rippling pennant of harmony. Marvel of marvels—this thing is true. The accounts from Nome, from Juneau, have not been exaggerated. The Arctic curtain blazes and pulsates; the domes of snow lie like giant sepulchres; the frozen creek is ribboned of silver. But the radio converts in this solitude of cruel beauty are oblivious to all but the miracle of song and music that comes homing through the air."

Complete isolation is almost a thing of the past. The radio telephone not only makes possible a recreative contact between the mining camp and the city, serving to encourage a sense of interdependence and friendliness, but it provides the engineer in the outpost of civilization with an interesting and profitable outlet for mechanical and electrical ingenuity in his spare hours.

The Selling Problem

THE SERIES of marketing articles which we have been running now for some time, and which eventually will be published in book form, should be studied carefully by those who propose to enter into new mining enterprises and those who are on the outlook for mining opportunities. The producer from the earth has to run the same market risk and take the same gamble as to the future course of supply and demand as does the manufacturer of clothing or of automobiles. The farmer raises potatoes one year, and succeeds in getting a fine crop, only to have to sell it for forty cents a bushel. Next year he speculates on cantaloupes and puts in many acres of them, and if the frost does not nip his vines, he may sell them at a handsome profit—or he may not. The demand for the different metals and the non-metallic minerals is quite as much a problem of popular demand. The prospector, the small miner, or the larger enterpriser should consider first of all what he can do with the produce if he succeeds in getting it. Do you dream of finding another nickel deposit, another Sudbury? You would not be able to profit by another Sudbury. The present Sudbury has far more metal than the world wants. An ordinary molybdenum deposit, or one of antimony, has no market value. The molybdenum business is almost entirely controlled by one group, and they have far more molybdenum to sell than the world can use for many years.

What constitutes pay-ore fluctuates from year to year, and with changing economic conditions. The business of mining does by far not stop with mining engineering. That too-current conception is as if the farmer should study only the methods of getting crops, disregarding the market. What was a mine ten years ago is in many cases no longer a mine. Ten years from now it may be a mine again. Gold mining was long a favorite with experienced operators, since the price was stable, and the market insatiable, but with war inflation this very stability of price operated so that gold mining suffered most cruelly, for while the income stayed fixed, producing costs rose so that many a good mine ceased to be a mine at all. Thus escape from the risk of general economic conditions proves impossible.

For a great organization, the mining of a variety of metals would distribute the risks most equally; but the smaller miner cannot undertake this. Smelting companies have the advantage of a fixed industry as a back-log to mining operations; and mining companies which go into the manufacturing business have thus an equalizing device to distribute the risk. The accurate prevision of economic events is difficult, if not impossible; hence the mining investor should ordinarily use the same principle of diversification as is preached for

investments in general and distribute his mining investments as broadly as possible, and balance them, if possible, with investments outside of the mining industry also. Carnegie's advice to "put all your eggs in one basket, and watch that basket," is, by and large, a poor one. It suited the steel industry better than it does any industry which depends on the production and marketing of a single item of raw material.

A Sidelight

THE CHILE COPPER CO. is now an important member of the Anaconda family. The adoption of this full-grown brother and wage-earner was ratified at the end of February, and steps were taken quickly to reorganize the board of directors so as to bring control of the South American producer completely in the hands of Anaconda shareholders. The deal is over, but, like many of its kind, possesses some romantic elements that are interesting to those who have followed the history of the enterprise. And the story is not so old, either. Just thirteen years ago, to take one of the details connected with the original acquisition of the Chilean property by Americans, Mr. Louis Ross, a mining engineer, was engaged in a search for a large low-grade copper deposit. His hunt was prompted by the suggestion of Mr. A. C. Burrage, who at that time was particularly anxious to procure one. Ross sailed for London, hoping to run across the offer of a suitable property in that mining center. Fortunately for him, he received the reports of six mines worth investigating, one of them being the embryo deposit at Chuquicamata, which was owned by Duncan Fox & Co., large exporters and bankers in South America. Ross studied the report and advised Burrage to option the property. Agreed. An option was secured, and Ross proceeded to Chile for the purpose of making an examination. There he succeeded in obtaining options on adjoining mining properties, options that ran from one to four years at considerations totaling about $1,500,000, but they included an immense deposit of low-grade ore.

Strangely enough, the options were first offered to Anaconda interests by Burrage, but they were not taken up by them. Hayden, Stone & Co. were also given the opportunity of developing the Chilean copper mine, but at that time the company was not considering ventures outside of the United States. The Guggenheims were then approached. They weighed the proposition, examined the deposit, and had it drilled to demonstrate its value. The subsequent chapters of the story are widely known. A company was organized whereby Burrage received $25,000,000 and the Guggenheims $70,000,000 in stock, while $15,000,000 was raised in bonds to equip and develop the mine.

Great responsibility attached to the work of the mining engineer in the early stages of the negotiation and optioning of the South American claims. Had Ross cabled to Burrage the private code word "Vozra," which meant "I advise dropping whole Chuquicamata business," the chain of events leading to the recent merger might never have occurred. Incidentally, Ross sued Burrage for 10 per cent of his profits, or 100,000 shares, but was awarded only $100,000 by the court.

Although the development of the Chile Copper Co. is the acme of technical progress in mining and metallurgy as applied to a certain problem, the men who have played a prominent part in surmounting its technical problems have not been the ones to reap the rich financial harvest attending the success of the project. The capitalists, the men with business vision who grasped the possibilities of Chile Copper, profited hugely from their foresight. The mining engineer and metallurgist was a means to an end.

The Diamond Control

IN THE SPEECH of the chairman of the De Beers Consolidated Mines, at the recent annual meeting, he referred in an interesting way to the benefit accruing to the diamond trade by reason of the control of diamond production exercised by the company and its associates. Owing to the slump in the diamond market, the De Beers mines were completely inactive for the twenty months preceding Dec. 27 last. The chairman stated that resumption was warranted by the signs of revival in a demand for their product, but there could be no hope "to do business of normal dimensions until the world trade generally flows into the well-balanced pre-war channels." Moreover, the "fairly sound conditions" of American industry, he said, justified the belief that there would be no "falling off in the demand from that quarter." The diamond trade had been saved from utter collapse, he insisted, by "the policy of control," for "if the Syndicate had, *pari passu* with the Russians, forced diamonds on an unwilling market, prices would have come down with a crash without sales being effected, consternation created throughout the whole trade, important firms of cutters and polishers in Amsterdam and Antwerp ruined, the effect on America would have been disastrous, and the recovery of the diamond market delayed for a very long period." During the meeting he read a telegram from a director, Mr. S. B. Joel, announcing that an agreement had been made with the diamond producers of the Congo and Angola, "thereby re-establishing full control of the disposal of all the principal producers' diamonds." Incidentally, it is worthy of note that the managers of the De Beers company have done much to prevent the scattering of their employees during the period of inaction; and they were met halfway, for the entire staff, including the general manager, agreed to accept half pay for one year.

Even Jove Slips

THEY occasionally accomplish big things in the mining industry in Boston. For instance, an enterprising individual with no ado whatever recently increased the copper production of the Arizona Commercial Mining Co. to 1,490,000,000 lb. for the month of February. That certainly makes the efforts of Anaconda-Chile, Calumet & Hecla, and Kennecott-Utah-Braden look childish. What is a paltry 50,000,000 lb. compared to this? About the same time some Bostonian created the Massachusetts Consolidated company, which immediately acquired two shafts on the Evergreen and Butler copper lodes in Michigan, two stamp mills with a capacity of 1,300 tons per day, and a "promising showing." This inventory of assets is suspiciously like that of the Mass Consolidated Mining Co., but that may be merely a coincidence. Between friends the difference between a ton and a pound is a matter of no consequence whatsoever; and abbreviations in Boston are an abomination, always. Perhaps the financial editors of the *Transcript* were all on a vacation. At any rate someone nodded on the erudite sheet.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

More Light on the Concentration of Rossland Ores

THE EDITOR:

Sir—I read with the greatest interest Mr. Eye's letter in your issue of Feb. 24, as no doubt did many others. In the early days of Rossland milling, Mr. Eye evidently fully realized the difficulty created by the low gold content of certain of the Rossland pyrrhotites. Before the adoption of flotation the beneficiation of a low-grade (in gold) cupriferous pyrrhotite, such as would result from coarse jigging, was not economically possible. Nowadays, if such a product be reground and floated on differential lines it is comparatively easy to obtain a copper-pyrrhotite concentrate and a commercially valueless pyrrhotite. It is to be noted that regrinding incidentally frees a certain proportion of gold from the pyrrhotite, and it is the aim to float this with the copper-pyrrhotite concentrate, damping the pyrrhotite.

If, then, it is highly probable that coarse jig products will finally require regrinding and an application of flotation, why not crush everything finely in the first instance? The answer is that if that is done the low-grade pyrrhotite is mixed with the high-grade and, *ipso facto*, you are denied the best results of differential flotation. The essential idea of the Hancock jig in my Rossland flow sheet is to keep the low-grade pyrrhotite out of the main flotation circuit. By means of this jig, the ore stream is divided into two circuits, the main circuit consisting probably of part of the jig middlings and all jig tailings, and another circuit consisting of all coarse pyrrhotite and a portion of the jig middlings. While in the case of both these circuits the whole is subjected to fine grinding and flotation, in the former case fine grinding will be required, there being no attempt to damp the pyrrhotite, whereas in the latter case there should be no difficulty, working on differential lines, in rejecting a low-grade (in gold) pyrrhotite, by subjecting the pulp, ground, say, to 60 mesh, to flotation.

Mr. Eye mentions the extraordinarily high-grade concentrate which it is possible to make by saving separately the uppermost band on the tables. He will be interested to learn that we followed this practice in Le Roi No. 2 mill, the product in question running up to $1,500 per ton in gold, although the feed to the tables never exceeded about $4 per ton in gold. The main bulk of Wilfley concentrates averaged approximately $20 per ton in gold.

I wish to tender to Mr. Eye my appreciation of his valuable and interesting contribution to the study of Rossland milling.

DOUGLAS LAY.

Rossland, B. C.

A Heart-to-Heart Talk With the Editor

THE EDITOR:

Sir—Once an enthusiastic lady inquired why I didn't come to her church. I told her I didn't think she really wanted to know, and that if I explained why, she would be hurt. This she denied emphatically and was insistent that I give my reasons, the upshot being that she doesn't speak to me any more. I hope you will be able to recover from any injuries my remarks may inflict.

As a matter of fact, I think my objection to the mental attitude of your editorial staff may be summed up in the very common expression: "He's a wise guy." You know what he is like. Explains everything. Knows everything. Rather intolerant of the humble opinions of lesser intelligences. Patronizing in his attitude toward those he feels must realize his superior qualifications and attainments, and generally letting it be known that he is "different."

And the sad part of all this lies not in the irritation the "wise guy" causes his friends, and all others with whom he comes in contact. It is rather in the fact that he cannot learn. To admit his ignorance is to admit his fallibility, and the "wise guy" is rightly loath to do this. And, really, on the whole, he is generally just a little ahead of the rest of us, mentally, if he would only utilize his energies in absorbing and teaching instead of impressing.

It is likely that I have exaggerated the facts with regard to the attitude of your editorial staff, but I will give a concrete example of what I am trying to drive at. Some time ago considerable furore (we are always in a furore about something, in the grand old U. S. A.) was created by the statements of a man named Vanderlip who was not the famous Frank. This man made some remarks about Russia which did not conform to the generally accepted view of the situation there, and which tended to give the impression that conditions might not be so bad as some overly enthusiastic condemners had pictured them. He spoke of concessions, and co-operation; he mentioned no blood on the street; he said nothing of difficulties in interviewing those in power, and did not call attention to their visionary and impractical attitudes of mind.

To all this the *E. & M. J.* took exception, and rightly too, for all I know. But their principal proof lay in discrediting the man, and you will recall how this was done. Attention was called to the fact that he had no "sheepskin." He was practically naked, so to speak, having nothing but a breech-cloth in the form of a correspondence school certificate.

Now, if this were an isolated case of the same spirit, which is not altogether confined to the matter of a college education, it would be harmless. I do want to say, at this point, however, that there is no denying the advantage of the man with the "higher education," although it is sometimes rather hard to discern, but, to use a figure of speech, it is rather in the extra weight which the so-called practical man must carry, than in

any inherent differences in their speed. Therefore, it ill behooves either of them to speak disparagingly of the other. However, this is beside the point. The thing which I do not like is the attitude of proving contentions by the clothes a man wears. It really made no difference whether Mr. Vanderlip had any certificate of any kind or not. The question was whether or not he had actually been in Russia and had seen and done the things he spoke about. Surely you do not reserve truthfulness to the college man; integrity is not guaranteed by a degree, and that alone, is it?

You see, the attitude is that of one who finds his previous statements refuted and who resents this. It implies some ignorance on his part, and, casting about for a defence, he attempts the rôle of superiority. He is the "wise guy," and can prove it by his better cut of clothing.

Another matter along the same line: I confess I don't like the self-congratulatory spirit of mining engineers as expressed in the *E. & M. J.* Most of those I know and associate with are not of this type. I have not been fortunate enough to come in contact with the editorial staff of the *E. & M. J.*, or some of its voluntary contributors, and I do not know how prevalent this spirit is, but if it is general I can only think of the little epigram about the self-made man who is proud of his maker.

You know, there is much in the Biblical admonition about not hiding one's light under a bushel measure, but there is also merit in the other adage that one should let one's good deeds speak for themselves. I never have any fear but that if I am competent and energetic I will receive due recognition. It is only when I am doubtful that I point with pride. In my experience I have found that men who called attention to their worth, honesty and capabilities too insistently were generally a little doubtful as to whether the world accepted them at their own value. In fact, they were a little doubtful themselves; hence the shouting, attempting to supply the deficiency in action by the superfluity in words.

As one who is vitally concerned in mining, I believe it is my privilege to criticize the fraternity to my heart's content, and I arise to remark that, on the whole, the mining engineer's intellect is inferior to that engaged in other more competitive affairs. The reason for this is not hard to find. It lies in the fact that, almost without exception, the mine makes the man. The competition is not there to stimulate the best effort; too much lies to chance. There is not the reward, generally speaking, and conditions are too temporal. For these reasons, the best brains, if you please, are not attracted, and those which do come in are tempted to leave too much to chance.

Confidentially, I will tell you that I admit it in my case. I wouldn't stay out in the wilderness if I thought I could do as well in another line of endeavor. But every time I come in contact with leaders in other fields of activity I realize how much superior they are to the men in my own field. And I suspect that the reason the *E. & M. J.*, as well as a good many other members of the fraternity, speak so well of themselves is because they doubt it. The hope is both father and mother of the thought.

Well, you let yourself in for this. I hadn't any idea of being called. And I hope you won't suffer enough to interfere with your writing an editorial regularly every week. Somehow, I don't feel very alarmed. I have a sneaking suspicion that you will struggle along, and hide the wound from the world. You may go home and abuse the wife, or kick the cat, but the rest of the world will never, never, know how badly you are hurt.

I thank you for the flattery implied by your inquiry. It isn't often that my reflections are sought, and never by those who know me.

With the best wishes for the *E. & M. J.*, and its editorial staff. VIETOR.

The California State Mining Bureau

THE EDITOR:

Sir—In your issue of Feb. 17th, you published a letter stating the new governor's recommendations concerning the California State Mining Bureau, and adding some comment. From the tone of the latter, I gathered that your correspondent has a poor opinion of the bureau and the work it is doing. Upon what this opinion is based, I have no way of knowing, but from my experience, covering many years, I have found the popular opinion to be that the bureau is a great help. There is no other agency in California more helpful to the mining industry in stimulating and maintaining a general interest.

This may not apply to the big operator, with his numerous staff, his voluminous files and complete reference library, and his established interests, but the average man, the man wanting an outlet for the mineral from his deposit, the man contemplating entering a manufacturing field and needing minerals for his products, the prospective operator of mines, the prospector wishing to learn whether he has made a valuable discovery—all these find in the California State Mining Bureau a starting point from which to broaden out. Sooner or later, these stimulated efforts need the directing hand of a technical man, and then indirectly the trained men of the mining profession reap their benefit from the bureau. Besides the financial reward just alluded to, the technical man finds in the bureau a never-ending source of general information.

In other words, it is to the little fellow, those who need the most assistance, the rank and file, thousands of us to whom the bureau has been of inestimable value. Whatever information is wanted, whether from the curator of the museum, the statistician, the librarian, or the mining engineer, it is given with promptness and with an accuracy that can be relied on. It is a pleasure to call there, because one in always assured of the best of treatment.

Your correspondent hints that the bureau's activities might be improved, but no mention is made in what manner. If there is anything to suggest, why not come out in the open and make the suggestions, because any improvement in the work of the bureau would react to the benefit of the mining industry. Undoubtedly the columns of the *Journal-Press* have been open to your correspondent for a long time, and his suggestions would have been gladly published.

It would be a heavy blow to have the activities of the bureau curtailed, and a disaster if abolished, a penny-wise-pound-foolish policy. Under Mr. Fletcher Hamilton, the bureau reached a high state of efficiency, and he deserves great credit. I cannot help but think that whoever advised the governor was either ignorant of what the bureau is doing or was misleading for a purpose.

This is written as a friend of the bureau; that has been my only connection with it.

San Francisco, Calif. JEFFREY SCHWEITZER.

The Immigration Problem

THE EDITOR:

Sir—Apropos of Mr. Rickard's two articles on immigration, it is an interesting fact that more than 30,000,000 immigrants came to this country during the last hundred years. As long as land was still open to settlement and there was ample opportunity to work, and as long as the immigrant was disposed to take his place as a prospective citizen, he was a welcome addition to the population of this country. But now, since neither new land nor plenty of work can be guaranteed, and because the immigrant is frequently an undesirable person, the problem of how immigration should be regulated is a serious one. Add to these conditions the fact that American workers and foreign employers oppose the migration of labor to the United States, whereas American employers and foreign laborers favor the migration of workers, and the situation becomes still more complicated.

Two quite different solutions have been proposed. In one plan it is assumed that the immigrant intends to become a citizen of this country and will establish himself here permanently. Therefore the plan proposes that a rigid inspection be made of the would-be immigrant in his own country in order to judge of his fitness and desirability before he arrives in the United States. Undoubtedly this is the best plan of keeping out undesirable persons. It would be much better than to reject the would-be immigrant at Ellis Island and send him back with little or no funds as a preparation for a journey of perhaps several days' duration from his port of embarkation to his native home, especially if he had sold his home or belongings to secure passage money. However, the heavy cost of maintaining abroad an adequate and well-trained force of examiners and the reluctance of foreign nations to permit our inspectors to pass judgment on their subjects will make the realization of this plan slow if not impossible. Furthermore, some foreign countries support emigration bureaus for the express purpose of aiding their citizens who wish to go to the United States. These emigrants are considered political assets by their mother country. They are also economic assets, since it has been estimated that the foreigners in this country send back home more than $600,000,000 a year. Some nations have thought of giving to their subjects who have emigrated to the United States, whether citizens here or not, a voice in the political affairs of their native country. Such divided allegiance could have only an undesirable political effect on this country.

Dr. Charles Eliot has recently expressed the opinion that the United States is not a melting-pot; in fact it has never been a melting-pot, for the immigrant is very likely to hold aloof from the life of this country. He is almost sure to join one of the 43,000 foreign societies and read one of the 1,300 foreign-language periodicals that flourish here. Our Americanization movement was designed to aid the immigrant to become a good citizen. But unless he is led to see the advantages of citizenship, and unless sympathetic consideration is given to his views and some attempt is made to understand and lead him, instead of forcing him into a common mold against his will, his assimilation into the life of this country will be slow.

The second plan is based on purely utilitarian grounds. If foreign workers can be imported into this country when labor is scarce, and then, when work is less plentiful, the surplus of workers can be shipped back to the mother country, there will always be on tap, as it were, a sufficient supply of labor. If steady employment can be provided for all those who are willing and able to work, the plan may be a success. But an exact balance between workers and the amount of work to be done cannot be struck in a progressive country. It might be roughly approximated, if industrial conditions could be stabilized. Employment in seasonal industries, such as agriculture or coal mining, and the cyclical or fortuitous business depressions which sweep over the country prevent the continuous employment of a large number of workers. Further, much time is lost in finding jobs for the laborers. A large number of men cannot afford to travel from one part of the country to another looking for work. A few years ago government employment exchanges greatly reduced unemployment in this country, but they are no longer maintained. It is estimated that in normal times more than 2,000,000 workers are unemployed. Even in 1917 and 1918, a period of exceptional industrial activity, more than a million men were without work. This was the lowest period of unemployment in the United States for twenty years. The fact that such conditions exist indicates that there is a pressing need for internal adjustment of industrial conditions. Until this is made, the subject of immigration will remain a debatable question.

ROBERT S. LEWIS.

Salt Lake City, Utah.

Mono Lake Gold

THE EDITOR:

Sir—In your Feb. 3 issue I read your editorial on Mono Lake. I also find part of it copied in the *Literary Digest* of March 10. Replying to this I will say that I was one of the original discoverers of the fact that these waters contained gold, and as there was only one other that knew of it we managed to keep it a secret for about two years, while working to perfect a process for extracting the gold. We did not want any publicity, nor do we now, for to the average layman it sounds like a pipe dream; but, unfortunately, a few promoters found out about it and raised money here in Portland for building plants at the lake before they really had a process. One of these is quite a noted chemist by the name of Parker, who at one time was a professor of chemistry in Columbia University. He built a small plant at the lake, and failed like the others to extract the gold in paying quantities. Another Portland company spent about $50,000 at the lake and likewise failed. Another plant, an electroplating concern, was erected on another lake, from which we were able to obtain better values than at Mono, at a cost of about $30,000. This also failed to produce the goods. I understand that Professor Parker has interested a banker with him and has unlimited money to continue his tests.

My partner and I, who all this time have been avoiding publicity regarding this proposition, feel assured now that we have worked out a process and expect to go to the lake shortly. So it really looks now as though "the old miners may turn over in their graves" and "mining engineers (the profession with a jellyfish backbone) will shrink with shame" as you term it. They are all right in developing a mine after it has been found, but I have never heard of them discovering any mines.

F. W. PECK.

Portland, Ore.

Diamond Fields of British Guiana

A Descriptive Sketch of Region and of Journey Thither From Georgetown—Occurrence of Stones and Conditions of Recovery—The Problem of Health

By Lloyd T. Emory
Consulting Engineer, 4 South 15th St., Philadelphia, Pa.

BRITISH GUIANA is the only possession of Great Britain on the mainland of South America, and is one of the three Guianas, little colonies situated on the northeast coast of the continent, between the mouths of the Orinoco and the Amazon rivers, belonging to France, Holland, and Great Britain. In shipping circles it is generally known as Demerara, and its chief claim to fame has been the Demerara yellow crystal, not diamonds, but sugar, which was highly prized in both England and the States before the day of the present refined white sugar. It is one of the most accessible and almost unexplored stretches of jungle that are just outside of our door. Only the coast of the colony has been settled, and the hinterland up to a few years ago had not been explored. In fact, there are several areas in it today about which little is known.

To reach Demerara, there are several lines of steamships running out of New York. If one has only a limited time, the Trinidad Line of steamers runs almost direct, stopping only at the islands of Granada and Trinidad. The latter is a tropical paradise, with the Pitch lake and oil fields to add interest for the engineer. On the other hand, if the time can be spared, a connection with the Royal Mail steamer at Bermuda will allow one to visit the most important of the tropical islands down the Windward Chain and see islands, bays, and harbors that equal, if they do not surpass in beauty, the Bay of Naples and other places on the Mediterranean.

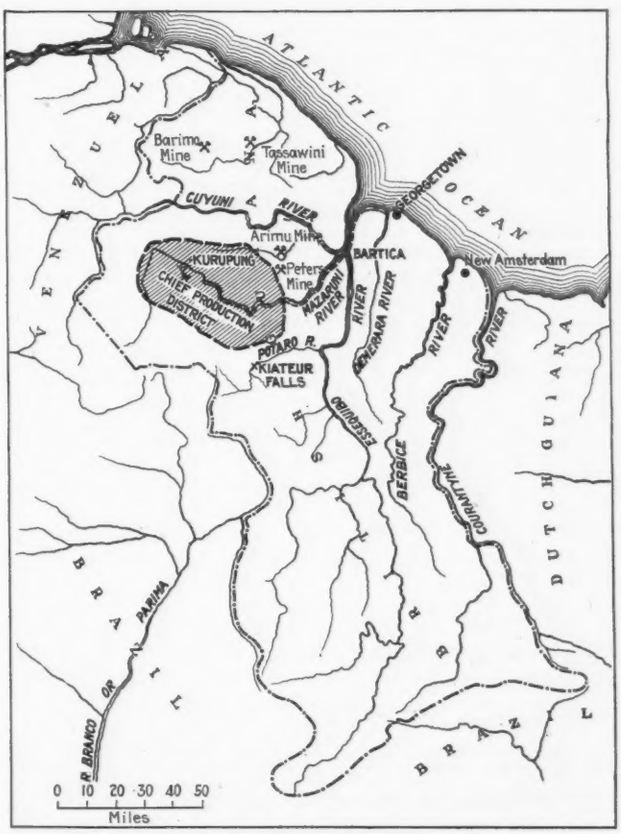
The first sight of the coast of the Guianas is anything but prepossessing. Through drifting rain showers, one is first apprised of the approach to land by the change from the deep blue of the Gulf Stream to muddy water, resembling pea soup—a result of the constant churning up of mud by the surf on an alluvial coast where there is not sufficient sand to form beaches. A lead over the side records four fathoms of water, and the captain begins looking for a small lightship that marks the narrow channel into the Demerara River. The coast is low, with mud flats extending 8 to 10 miles seaward. Excepting at points where there are groves of mangrove trees, or the chimneys of sugar factories, one can ground in a boat of shallow draft without seeing land at all.

Capital Below Sea Level

Georgetown, the port of entry, is a city of 60,000 population and has the distinction of being below sea level, and of having one of the most beautiful botanical gardens in the world. Dikes keep out the tide, which has a maximum rise and fall of about 11 ft. The rainfall is often over 100 in. per annum, and the temperature varies between narrow limits throughout the day, or from 74 to 89 deg. F. The variation between the mean maximum temperatures of the so-called warm and cold months is only 3 deg. F. and is much less than the daily variation between midday and midnight.

From the flat alluvial coast lands where sugar and rice are grown, one must travel 40 or 50 miles inland to reach the foothills, and 100 miles inland to really be in the mountains. In other words, the country consists of a belt of alluvial coast land, much of which is below the level of high tide, a chain of foothills consisting largely of sand, and an inland plateau traversed by mountain ranges

The colony has 435 miles of boundary in common



Map of British Guiana, showing location of diamond fields

with Venezuela, 762 miles with Brazil, and 440 miles with Dutch Guiana, but along this entire distance of 1,637 miles there is not a single railroad or road for wheeled vehicles of any kind crossing the boundary. A few trails used principally by the aboriginal Indians are the only mode of entering the colony, except by sea.

Just a line on the history of the region may be of interest. In 1595 Sir Walter Raleigh sailed along the coast and ascended the Corentyne, Berbice, and Essequebo rivers, about as far as the average explorer goes today; for few penetrate beyond the second or third series of rapids or falls with which the rivers are blocked.

Soon after this date, Dutch traders began visiting

these shores, and in 1613 established a fort on a little island near the juncture of the Mazaruni and Cuyuni rivers, known as Fort Kijk-over-al. Its ruins can easily oe seen from the boats on the Mazaruni, carrying men to the diamond fields, or from Mr. Beebe's camp and tropical laboratory on Katarbo Point. From this small beginning the Dutch spread over what is now British Guiana. Between 1781 and 1814 the colony was held alternately by French and British. In 1814 it finally became British and has remained so ever since. With the abolition of slavery in 1838, many of the plantations up the rivers were abandoned, and at present the coastal plain supports probably 95 per cent of the inhabitants.

Diamonds First Found in 1890

Sir Walter Raleigh failed to find either gold or precious stones during his explorations. It was not until 1863 that gold was discovered. Since 1886, when mining can be said to have really become an industry, about 2,630,000 oz. of gold has been produced. In 1890 an expedition, working placers for gold on the upper Mazaruni River, found several small diamonds in their pans, which at the time caused little comment, but made a beginning for the present-day paying industry. In the year ended July 1, 1902, 91,206 stones, weighing 8,227 carats, were entered at the office of Commissioner of Lands and Mines. The accompanying table gives an idea of the rapid growth of the industry.

Number and Weight of Diamonds Declared at the Guiana Department of Lands and Mines, 1901 to 1921 Inclusive

Year	Number	Weight (Carats)
1901-1902	91,206	8,227
1902-1903	163,680	10,447
1903-1904	164,315	10,742
1904-1905	175,400	10,619
1905-1906	65,752	4,097
1906-1907	65,903	4,661
1907-1908	29,007	2,122
1908-1909	63,161	5,618
1909-1910	85,537	7,181
1910-1911	26,467	3,035
1911-1912	78,683	7,648
1912-1913	62,624	6,099
1913-1914	93,752	11,119
1914-1915	100,522	13,716
April to December, 1915	19,461	3,678
1916	93,782	16,409
1917	102,957	17,908
1918	77,819	14,196
1919	84,466	16,706¼
1920	234,456	39,362⅜
1921	507,200	102,603⅜
Total	2,386,150	316,194¼

Rapids in Mazaruni River up which boats bound for diamond fields must be hauled

Ruins of old Dutch fort on Kijk-over-al, Mazaruni River

Let us, however, return to Georgetown, the port of entry, where there are several good hotels, run at reasonable rates, and general stores where one can get all the necessary equipment for bush travel.

The start for the diamond fields is over a light railway, running parallel with the coast, and connecting the ferry at Georgetown with a steamer landing, near the month of the Essequebo River, at Perika. This part of the trip is through rice fields and sugar plantations. The tropical vegetation and villages of East Indian laborers are always of interest to the newcomer.

Although the cars are small, jolty and usually crowded with an exceedingly cosmopolitan passenger list, the two-hour trip is, for the first time at least, intensely interesting. For a fuller description of this part of the colony, one should read the books of William Beebe.

The second stage of the journey is by a small government steamer that runs on alternate days up the Essequebo River to its junction with the Mazaruni, to what may be termed a frontier post, the little town of Bartica. The 35 miles of river travel, with several stops at islands where natives with tropical fruits for sale crowd the docks, is always pleasant, and the broad, island-studded Essequebo is a river that will fail to enthuse only the most weary of travelers.

Bartica "Jumping Off" Place for Diamond Fields

Bartica, the end of the first day's journey, has limited accommodations for the white man, and one may prefer to take the "jump off" at once, although the steamer arrives quite late in the afternoon. From this point every one has to provide his own transportation, unless he joins some other party. Boats of several tons' capacity, manned by crews of ten paddlers each, with a bow and stern man, up to a few months ago were standard equipment. Recently, several launches have been built, of special design, to run the rapids, and these tow one or more freight boats. This part of the journey takes from twelve to twenty-six days, although

under favorable conditions the launches are now reported to make it in from eight to ten days. It is about 175 miles from Bartica to the mouth of the Kurupung.

The trip is the hardest sort of work for the boat crew, who, besides paddling on the smooth reaches of the river, have to haul the boat by main strength, awkward because of the many rapids. Sometimes a long tow line taken ahead does the trick; at others the boat has to be almost lifted bodily, by everybody getting over in water from waist to armpit deep. It is always a wet and fagged-out bunch of men who make camp late in the afternoon and cook supper before rolling into their hammocks. As it rains practically every night, tarpaulins have to be rigged up for shelter or palm leaf roofs constructed. Food, for the men, consists principally of salt fish or pork and rice, and it is probably due to this meager diet that so many of them become sick.

Accidents due to boats swamping or being overturned in the rapids are frequent, and several fatalities happened last year. For example, in August, a boat bound up the river capsized in the first rapid above Bartica, drowning five of the crew.

A. Wright, an American, who returned from a three months' prospecting trip about the middle of October, reported making the run down the Mazaruni from the Kurupung to Bartica in five days, passing en route fifty-seven boats bound upstream laden with stores and carrying over a thousand men.

Diamond Area Hilly, Wooded and Cut by Many Creeks

The area where diamonds have been found is quite a large one, extending east and west along both banks of the Mazaruni for upward of a hundred miles. To the north, diamonds have been found over the watershed in the tributaries of the Puruni and to the south along creeks flowing into the Kuribrong, one of the large branches of the Potaro. The district is semi-mountainous, badly cut by cross drainage of the small creeks and covered with a dense tropical forest. Prospecting is slow and tedious, to say nothing of the difficulties in getting in provisions which have to be packed on the backs of porters after leaving the boats. The following is an extract from one of the first reports of E. E. Winter, of the Department of Lands and Mines, who was appointed Warden of the district in December, 1921:

"The geology of the Mazaruni River is described in the 'Geology of the Goldfields of British Guiana,' by Sir John B. Harrison, M.A., published by Dulau & Co., London. The rocks met with in the Tacouba Creek area are dolerite conglomerate (including sandstone) and granitite, of which dolerite is the most recent and granitite the oldest.

"The surficial deposits in which the diamonds are found consist of the detrital products of these rocks. The gravel is derived almost entirely from the conglomerate and consists of quartz pebbles of all colors.

"The diamonds are accompanied by certain heavy minerals such as tourmaline in the amorphous as well as the crystalline form, black sands which consist largely of ilmenite with some ferromagnesian minerals, and gold in greater or less quantity.

"The tourmalines are considered by the diggers to be diamond indications. They certainly indicate a concentration of heavy minerals, and the chances are that among these there will be some diamonds.

"The source of much of the tourmaline is the granitite, and the black sands and gold can be referred to the dolerite, but all these minerals are also found in the conglomerate. The field relations also indicate that the diamonds have reached their present position as a result of the disintegration of the conglomerate.

"The primary source of the diamonds is no doubt a series of volcanic pipes, or large areas of very basic rocks; but so far no trace of these has been found, if we except an exposure of micagabbro in the Issenaru-Haimarakka district.

"The gravels derived as described above were deposited along the courses of the streams into which they had found their way. As the streams shifted and deepened their channels, much of the gravel was left raised above water level as terraces forming what are termed the deep deposits. These terraces were dissected by the tributary streams as they develop and their contents of diamonds concentrated in the stream beds by the removal of the lighter and valueless material. In this way the shallow deposits were formed, and it is from this class of deposit that the great majority of diamonds are produced today. In this class the overburden varies from a few inches to 3 or 4 ft. The pay gravel is 6 in. to a foot thick. An example of a rich creek is a claim on Puzzle Creek, right bank Tacouba, which averaged 80 to 100 carats of diamonds from 5 cu.yd. of gravel. Some of the stones weighed up to 10 carats. The average local sale value was $20 per carat.

"In the deep deposits the gravel is 40 to 50 ft. deep. Values, both in gold and diamonds, begin 10 ft. from the bottom and improve in depth. Up to the present few of these deposits have been worked, owing to lack of mining knowledge and the great difficulty and cost of conveying even the lightest machinery to the diamond fields by the existing means of transportation. It has not been found possible to work to a greater depth than 25 ft. in an open cut with manual labor, but wherever bedrock has been reached at this depth the returns have been high. In one case 1 cu.yd. of gravel off the bedrock produced 20 carats of diamonds and 10 dwt. of gold. These deep deposits can best be worked with a light, cheap plant of machinery. An essential part of such a plant is a machine in which the final separation of the diamonds is accomplished without the intervention of any of the laborers.

"The shallow deposits are best worked as at present by the native diggers with the sluice and tom.

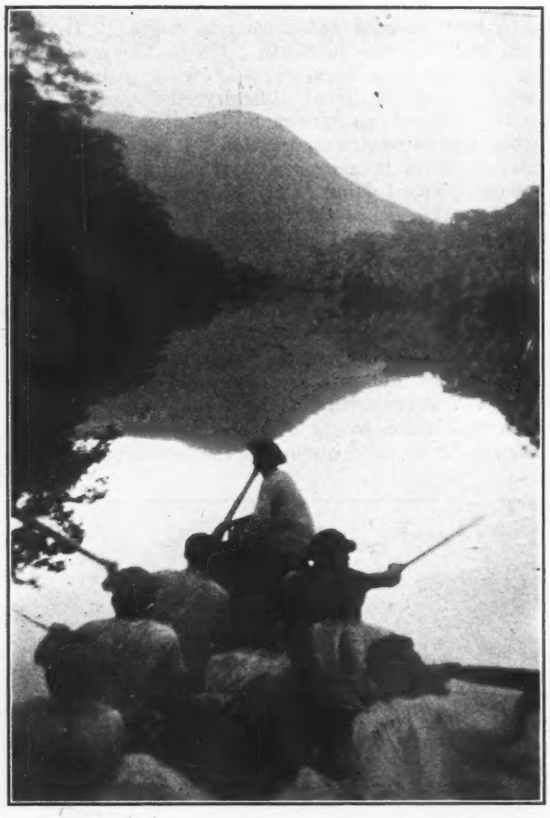
"Transportation to the diamond fields is by boat on the Mazaruni River, and owing to the numerous cataracts it

Potaro River, looking downstream from brink of Kiateur Falls

is difficult and attended by a certain amount of risk. All the traders in the district run boats at regular intervals to keep their stores supplied and they also carry passengers and freight for other parties. Native passengers are usually carried on the understanding that they will assist in 'pulling paddles' in the boat, but this is of course open to negotiation with the owner of the boat. The time occupied on the journey by river varies from twenty to twenty-six working days, according to the state of the river, but the journey has been done in small boats with an outboard motor in five days and by a 36-hp. launch in ten days when the river was in flood. Freight rates are from $135 to $180 per ton. Instead of traveling in a trader's boat, men, food and equipment can be conveyed in a boat purchased for that purpose. The maximum size of boat permitted by the River Navigation Laws is 40 ft. x 7½ ft. x 2 ft. 10 in., having a capacity of about four tons in addition to the crew of twenty men and their baggage.

"For the navigation of this boat through the falls the law requires that the steersman and bowman shall have certificates of competency. These are issued by the government after strict examination.

"The cost of such a boat with its equipment will be about $650. The wages of the steersman are $60 and of the bowman $40 per month.



A quiet stretch of river. Boat crew in foreground

"Labor in the diamond fields is provided by the negro race. Laborers drawn from the other races are rarely satisfactory. The East Indians especially are not sufficiently robust to stand the rough life of the diamond fields. Wages very from 80c. to $1 per day, and the laborer has to be fed as well."

The most productive area worked during the last year was the Kurupung Creek, a tributary on the right or south bank of the Mazaruni. Until last year little was accomplished in the way of an organized effort to help or control the industry. Under the old scheme, merchants in Georgetown operated lines of shops up the river. The diamond diggers, or "pork-knockers," as they are locally called, are negroes from the coast villages who work their way up-river as paddlers on the provision boats. The shopkeepers staked claims on which the pork-knockers worked. They sold the laborer his supplies and bought his diamonds. Naturally, under such conditions, supplies were high and diamonds low. Only the fortunate washers found enough stones to save a few to take to Georgetown to sell the independent buyers. Chinamen have been among the most successful of the shopkeepers, and several who have not only provided for the black man in the bush, but looked out for his wants when he returned to town, have been exceptionally successful.

At the beginning of 1922 there were eight independent buyers in Georgetown, and since then two concerns, an English syndicate under Viscount Dunsford and an American company, represented by William J. LaVarre, have undertaken extensive explorations and the improvement of transportation facilities.

Factors Contributing to Present Boom

The present boom, which started in 1919, when a production of 16,706 carats was recorded by the Department of Lands and Mines, seems to have been the result of several favorable factors. These were:

First, the demand for and a rapid rise in the price of diamonds following the war.

Second, the discovery of the rich territory along the Kurupung and the finding of several large stones.

Third, the release of a large number of laborers from the coast lands, due to the fall in the price of rice and sugar in 1920.

The coming in 1921 of independent buyers in Georgetown undoubtedly stimulated the industry. The complete figures for 1922 have not yet been published, but from Jan. 1 to Dec. 15, the customs department at Georgetown reports the export of 139,899 carats, valued at $3,220,604. The production for the year may reach 150,000 carats.

Stones Average Six to Carat

The diamonds are of a good quality and average about six to the carat. Stones of one or more carats are frequently found. The largest ten stones so far reported have weighed 29$\frac{5}{16}$, 18$\frac{1}{8}$, 17$\frac{1}{2}$, 15, 14$\frac{3}{4}$, 14$\frac{3}{8}$, 13$\frac{1}{4}$, 13, 12, and 11$\frac{3}{4}$ carats, respectively.

The largest stone, weighing 29$\frac{5}{16}$ carats, and locally known as the "Kurupung," was picked from a heap of gravel that had passed over the screen, and came near being missed, as it was so much larger than stones the picker was accustomed to finding. It was brought to Georgetown in December, 1921, by the two colored men owning the claim, and sold for a little over $4,000 to Mr. LaVarre. The stone, a twin crystal, had a groove around the center which probably necessitated its being sawed in two in cutting. It had a slightly greenish cast in the rough, but this might have been due to surface discoloration. Mr. LaVarre arrived in New York in January with the stone and received considerable newspaper publicity. The stone was not, however, the largest ever found in the western hemisphere, as stated, a stone weighing 254 carats having been found some years ago in the Province of Minas Geraes, Brazil. Several other stones weighing over a hundred carats each have been reported from the same source. However, though large stones fire the imagination and aid in advertising, the trade prefers stones running from one to three carats in the rough.

Returning to the practical side of securing the stones, the mining laws of the colony are unusually liberal. The following is an abstract of the present regulations:

A license to enter the bush and prospect on all unoccupied Crown land is issued on the payment of a fee of $5.

The holder of the above license is allowed to stake a claim of 500 acres, on which he must pay an annual rental of 50c. per acre, also a fee of $25 for what is known as an "alluvial certificate" for each quarter-acre actually worked.

There is a royalty or super-tax of 20c. per carat on the excess over 250 carats produced from each quarter-acre, or the area covered by the alluvial certificate.

All diamonds brought to Georgetown must be entered at the office of the Commissioner of Lands and Mines. Diamonds can be exported only through the local banks, except in special cases where a written permission is granted by the Governor of the colony.

At the present time there are undoubtedly a lot of claims in good territory that have not been staked. It is certain that a white man could not, however, go in on a shoestring capital and work as do the blacks. Few men born in the temperate zones can stand hard manual labor in the tropics. Furthermore, owing to race prejudice, it is likely that the white man would not be permitted by the blacks to do it, even if he could. The law, of course, would be on his side, but conditions are such that he could hardly survive the force of local custom. Although there are several thousand black and colored men in the bush, there are probably not more than a dozen white men of foreign birth.

From the figures already given, it can be seen that to finance an expedition would cost from $1,500 to $2,000. A reserve sufficient in amount to pay one's expenses back to the United States in case of failure should be set aside. Nothing could be more disastrous than being stranded in a tropical port like Georgetown.

As in most tropical work, the real problem is that of maintaining one's health. Since 1915 I have spent a large part of my time in the Guianas, including many months of travel in prospecting work in the bush, without a day's sickness, except an attack of influenza in 1918. So it can be done, but moderation in habits and care as to drinking water and food, similar to the care taken by an athlete in training, is necessary. Malaria, typhoid, and dysentery are far more to be feared than wild animals, snakes, and natives. In fact, I have often traveled alone for days with no other weapon than a bush knife, but the bottle of boiled water was never forgotten.

At present there are probably between 6,000 and 7,000 black men in the diamond fields, all of whom are more or less infected with malaria, filaria, hookworm, and intestinal diseases. Little, if any, precautions are taken by them to insure sanitation. Old workings are excellent breeding places for that scourge of the tropics, the mosquito. Streams, polluted with camp refuse, although crystal clear, are dangerous drinking water.

The following is an extract from a recent request of the Warden for a dispenser of medicinal supplies:

"During my stay in the district, there were several deaths in camps aback, and at the waterside, and I often met men being carried out in hammocks to be sent down the river. In many cases these men died in the boat, before it reached the mouth of the Kurupung River. One of the deaths aback was that of O. H. Tofty, a citizen of the United States and an experienced miner.

"The chief cause of the trouble is of course a polluted water supply. I do not see how this can be prevented in the case where several thousand men are concentrated in a small area like that on the right bank of the Tacouba Creek. Notices reserving a creek for drinking purposes can be posted on the main lines, but these will not be known to dozens of prospectors who will be crossing this creek at other points with lines cut from an entirely different part of the district."

On the other hand, P. K. Sweet and A. Wright, geologists, returning from a three months' trip about

Prospector panning gravel for diamonds

the middle of October, reported that although they had covered most of the territory occupied by the producing camps, neither of them or any of their fifteen men had been ill during the trip.

To any one having a love of the great outdoors and a spirit of adventure, such a trip would be well worth the cost, especially if a visit to Kiateur Falls could be included in the itinerary.

Zinc Leaching at Rhodesia Broken Hill

The experimental electrolytic zinc plant at the Rhodesia Broken Hill mine is at present obtaining good results. A brief summary of this process in *Chemical Engineering and Mining Review* is as follows: Ore containing lead, zinc and vanadium and regenerated acid is fed into the ore leach. The solution from the ore leach goes to the vanadium precipitation tank and from this to the silica precipitation tank. The silica and vanadium are pressed out together in a filter press. The solution now passes to the purification process, in which traces of iron, arsenic, and nickel are removed. These and other impurities are separated in the press. The purified zinc sulphate solution is then fed to the electrolytic cells and the zinc is deposited on sheet aluminum cathodes, and the sulphuric acid is regenerated and used again.

The vanadium and silica in the form of a cake from the press is releached and the vanadium is again separated as a cake containing 20 per cent of V_2O_5 (vanadium pentoxide). This cake is finally re-treated for production of fused V_2O_5 free of phosphorus. The phosphorus is discarded in the form of ferric phosphate, which may be of value as a fertilizer.

Setting Diamonds in Drill Bits

Varied Assortment of Tools Required—Position and Shape of Stone Must Be Carefully Considered—Forces Acting on Bit Analyzed

By George J. Young
Associate Editor

SETTING A DIAMOND in a diamond bit is somewhat similar in principle to setting a filling in a tooth, and the diamond setter develops a skill which is comparable to that shown by a good dentist. Seldom have the tools of the diamond setter been described, and this is probably because each diamond setter has his own kit. The work of diamond setting is a necessary accessory to diamond drilling and is done usually on the job. On the thoroughness of the setting depends not only the success of the drilling but also economical use of diamonds and reasonable costs.

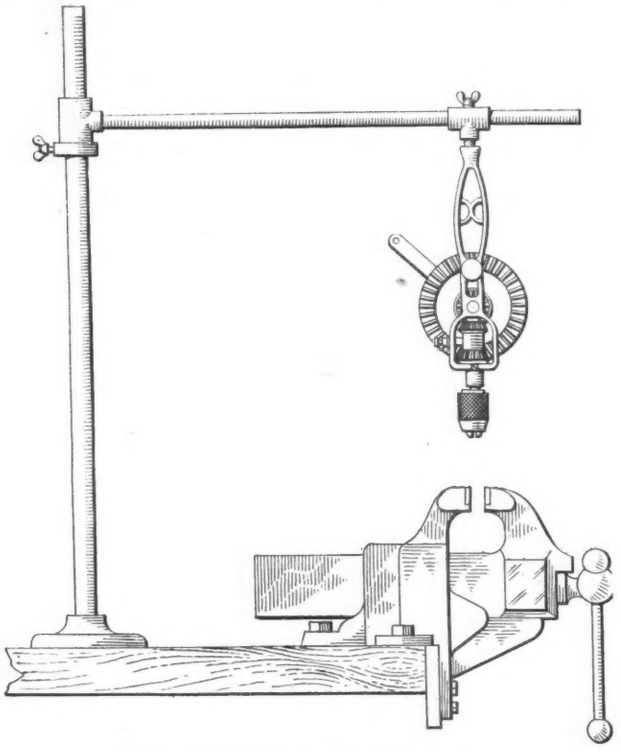


Fig. 1—Vertical stand and vise

A good diamond setter should have excellent mechanical training and familiarity with the tools of the craft as well as a good eye and innate aptitude for the task. Diamond setting is a fussy job, but it cannot be done in a fussy manner. To begin with, a good light is necessary. Next, a solid bench about six feet long with a low edge to prevent tools from rolling off, equipped with a good vise, is essential. The top of the table should be smooth and free from cracks. The only other fixture necessary is a vertical stand which can be extemporized from pipe, pipe fittings, and a floor flange as shown in Fig. 1. This stand is used to support a breast drill, and downward pressure can be obtained by pulling down upon the end of the horizontal rod.

To hold the bit rigidly in position in the vise, a bit holder made as shown in Fig. 2 is used. The bit screws into the upper end as shown. It can be placed horizontally or vertically as required. The necessary tools fall into several classes—measuring, cutting and drilling, calking, swaging, and miscellaneous. The tool kit comprises the following: For measuring, two pairs of inside and outside calipers and a caliper square with inside-outside jaws; for cutting, a diamond point, a cape chisel, and small cold chisels of various sizes; for drilling, twist drills from $\frac{3}{16}$ and $\frac{1}{4}$ in. diminishing by $\frac{1}{32}$ in. successive sizes and both wire gage and regular sizes; off-set, round-nose, and square and round-end calking tools; swages, center punches, and sets; miscellaneous, three sizes of ball-pein hammers, 4, 8, 12 oz.; a "pick," copper set, snips, 10-in. Stillson wrench, pincettes, gage rings, magnifying glass, and portable balance with carat weights.

The tools used in setting the stones are shown in Fig. 2. In setting a diamond the bit is marked by means of a center punch at the positions of the principal stones. The stones are carefully selected, larger stones for the important cutting positions and smaller stones, used stones, or fragments for the clearance positions. It is worthy of note that the diamonds as purchased are chosen from a stock first selected by the dealer.

Having selected a stone, it is carefully studied and its best cutting position decided upon. Its maximum diameter is measured, as well as its maximum height. The cutting surface of the stone is so placed that it will be $\frac{1}{100}$ in. above the bit. The proper diameter of bit is then selected and a hole of the right depth bored. By means of the chisels the hole is trimmed and cut to take the diamond. Copper strips are cut with the cold chisel and wedged in around the diamond until it is securely held at all points. These bits of copper seat the diamond on the bottom and sides. The steel of the bit is then swaged all around from a sufficient distance back to afford enough metal to close in about the diamond. The "collar" of metal thus drawn around the upper part of the diamond is gradually swaged closer and closer, avoiding any pressure upon the diamond. It is finally drawn down upon the diamond, the setter closing it in from the bottom up until the diamond is almost buried in the steel. The last operation consists of calking the fringe of metal about the stone until it bears evenly upon it at all points and leaves only the upper surface of the stone exposed. This operation is a delicate one, for the setter must hit just hard enough to draw the metal without allowing the stone to get any more than a light effect from the blow. There is danger of splitting the stone, especially in calking.

The diamond setter will find it to his advantage to study Fig. 4, in which are illustrated the forces to which a diamond in the bottom surface of the bit is subjected. The forces of outside application are due to the thrust or weight of the drill rods and the rotation of the bit. The tendency of these forces is to rotate the stone in its setting. The irregularities of the

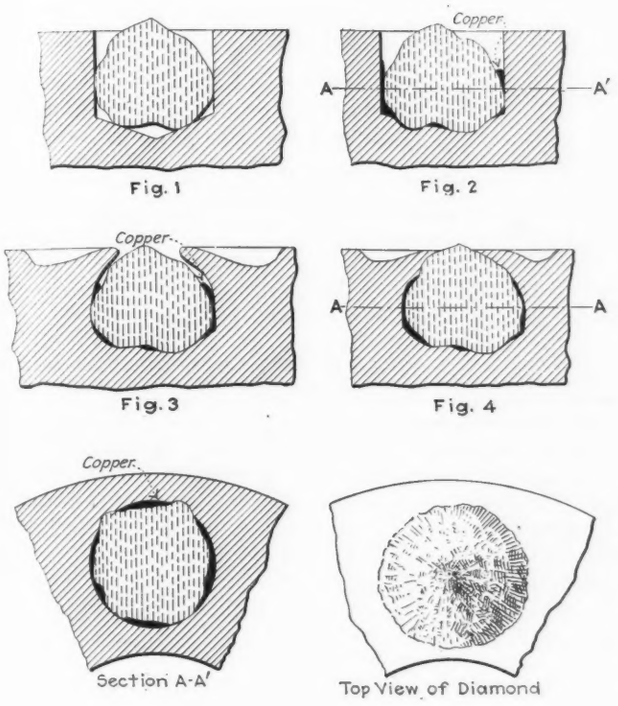


Fig. 3—Successive steps in setting diamonds

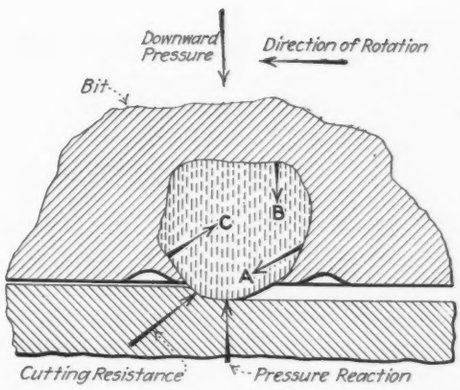


Fig. 4—Forces acting on diamond in the drill bit

diamond, and the seat formed for them, resist the rotation. The arrows *A*, *B*, and *C* in Fig. 4 indicate the direction of the forces acting on the diamond.

Determination of the best position in which to set a given stone does not admit of fixed rules, but is based upon experience and experienced judgment. Different diamond setters will agree that there is one position in which a given stone can be set and in which it will be safely held and will cut with minimum wear.

Acknowledgment is made of the courtesy of H. D. Staley, who permitted me to observe the setting of a bit. N. H. Wright discussed the subject with me.

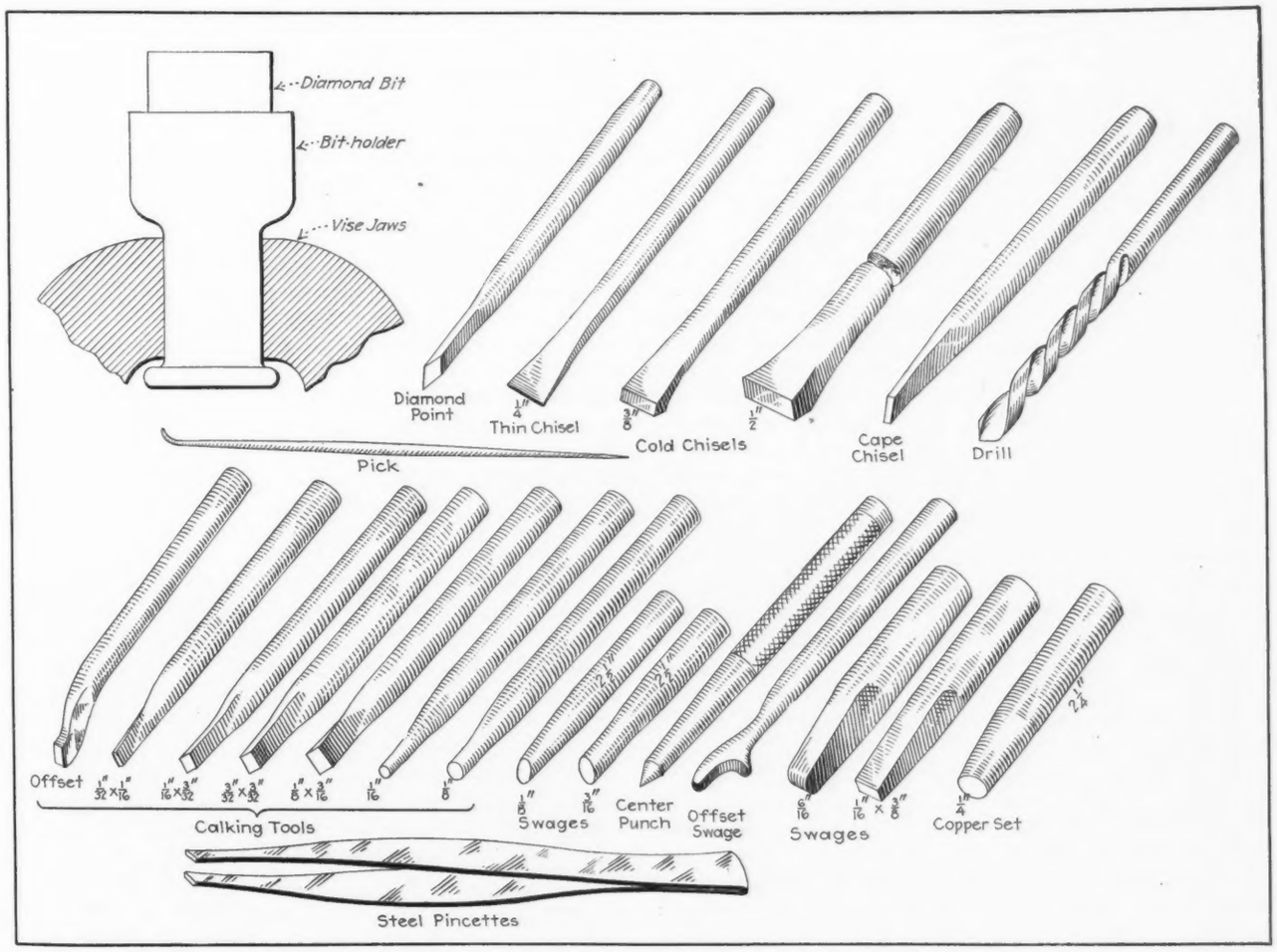


Fig. 2—Tool kit of diamond setter

The Ica Copper Region of Peru

Deposits Near the Coast Worked Profitably Prior to 1885—High-Grade Ore Shipped — Geological Conditions — Comparison with Chilean Deposits

By A. B. Reader

THE COPPER MINES of Peru are associated in the minds of most people with remote and rather inaccessible localities in the high Andes. The Cerro de Pasco and Backus & Johnson properties are typical. However, prior to the Chilean-Peruvian war, in 1879-1884, considerable quantities of high-grade copper ore were mined and exported from deposits along the coast, especially in the vicinity of Ica, where most of the development was done. The distinguished geologist and scientist, Prof. Antonio Raimundi, to whom we owe most of our existing knowledge of the geography and geology of Peru, in his work on the "Minerals of Peru" (Vol. 5, pp. 81-83), writes:

"It can be said that copper exists all along the coast of Peru, the most important zone being that comprised between Ilo and Pisco. The copper ores on the coast of Peru are equal to those on the coast of Chile. . . . The Peruvian territory is immensely rich in copper ores along the whole coast, especially in the districts of Canzas and Tingue, in the Province of Ica. The copper ores, atacamite, malachite, and chrysocolla, are found at certain depths all along the Peruvian coast, and at greater depths cuprite appears, accompanied by native copper or by malachite, azurite, and green carbonate of copper. At a certain depth the oxychloride of copper disappears entirely, as also the other oxidized ores, and chalcocite in an almost pure state occurs, accompanied by covellite (copper sulphide). In some instances the covellite appears at only slight depth accompanying the oxidized ores."

The Ica copper veins were known and were exploited on a small scale by the Incas and the Spanish conquistadores, but it was only in the year 1873 that the region began to be known and worked on any considerable scale. To an enterprising Italian miner named Narducci, associated with the famous builder of Peruvian railroads, Henry Meiggs, is due the prospecting and development of the numerous copper veins in the vicinity of the town of Ica, which is connected by standard-gage railroad with the first-class port of Pisco, about 46 miles distant. At Ica one can hire an automobile in the main square and reach the mines, over a comfortable road, in something less than an hour's interesting ride. Narducci discovered over thirty deposits, many of which had been previously opened and worked by the ancients; he found high-grade copper ore on various dumps, as the former miners had been able to treat only the oxidized ores, discarding the rest as of no value. The three copper regions in the close vicinity of Ica are known as San José de los Molinos, Canzas, and Tingue (the latter also including the adjacent Yauca district).

Work was first begun by Narducci in the Canzas district, as it was considered the best, but when the richer deposits of that region were exhausted, he developed and worked the San José de los Molinos and the Tingue districts with satisfactory results. No attempt was made to treat the ore locally by means of the modern metallurgical methods, and only the highest grade ores could stand the expense of mining, transportation, and export to the markets of Europe and the United States. In 1884 work was stopped on all of the mines owing to the disastrous effect of the war between Chile and Peru. In that year Narducci, as he had amassed quite a considerable fortune, retired from the region.

Only ores that contained 20 per cent copper or better were exported during this period, the rest being thrown back on the dumps or into the shafts. During eight years of exploitation Narducci exported through the Pisco custom house from the Ica mines about 24,000 tons of copper ores that averaged 25 per cent copper or better. The mines remained in a state of complete abandonment from 1884 until 1901, when, owing to a rise in the price of copper, there was a short renewal of mining activity, when the miners devoted their attention to stripping old pillars in the mines and dumps of the higher-grade ore. During the periods 1889-1903 and in four months in 1905, 389 tons of 27 per cent copper ore was exported from the Ica region.

According to the printed reports of conservative mining engineers (among them Frederico G. Fuchs, J. Ernesto Gianella, and Robert F. Letts) there still remain on the dumps and exposed to view in the mines over 70,000 tons of copper ore that will average 10 to 15 per cent copper, and which only requires treatment by smelting or lixiviation to be profitably exploited.

There appear to be approximately forty copper veins that have been partially developed and worked in the three districts of the Ica region. The width of the veins varies up to 8 ft., some of them being traced by their outcrops for a distance of 2,600 ft., the inclination varying between 70 deg. and the vertical. In the Adelaide mine, in the Canzas district, a depth of 660 ft. has been driven down vertically without reaching the bottom of the orebody. At this depth water was encountered, and the presence of an abundance of rich sulphides disclosed. Sulphides have also been encountered in the Peru mine, in the Tingue region, and in the Azurita (formerly Narducci) mine, in the San José de los Molinos district.

Narducci reports that in the lower levels of the Azurita mine, rich, dark-colored sulphides appeared that contained as high as 60 per cent copper. From the transition zone of the Peru vein, in the Tingue district, samples of copper ore were obtained that indicated the existence of a rich, underlying sulphide zone.

The hills where these veins occur consist mostly of labradoritic diorites associated with epidote and magnetite. Calcite, manganese, antimony, and arsenic are very rare, although there is an abundance of limestone in the Canzas region and large masses of hematite and magnetite occur in the Tingue region. The veins in their upper parts consist of oxides, malachites, atacamites, and oxi-chlorides, and in the lower levels, about 660 ft. below the surface, occur bodies of rich sulphides, the vein-filling consisting of iron pyrites and chalcopyrite. The copper veins of the Ica region resemble in their geological characteristics and formation the copper veins of the Chilean coast that are being exploited so successfully by North American companies.

The Cyanide Plant of the Nurupi Mines, Korea

Revision of the Flow Sheet Reduces Costs Greatly, Though Extraction Is Still Low—Graphite an Interfering Element—Canvas Table Concentration and Combined Sand and Slime Leaching Now Practiced

BY CHARLES FLURY

Charles Flury

THE MILL and cyanide plant of the Nurupi mines, of the French Mining Concession of Chang-Song, Korea, has recently been enlarged and the method of treatment modified to effect a marked reduction in cost. In 1915 there were thirty stamps, and the leaching plant contained eighteen 22x5-ft. iron tanks. The flow sheet, Fig. 1, shows the practice from 1915 to 1920. During this five-year period, the ore ran about 25 to 30 yen per metric ton. (One yen is about 50c. in United States currency.) The gangue, which was rather soft, consisted of quartz, with a considerable amount of clay and graphite. Pyrite, marcasite, galena, and, to a less extent, zinc blende, carried the precious metals. As the gold is exceedingly fine, the cyanide readily dissolves the gold that is amenable to amalgamation.

Extraction and costs were as follows:

Extraction and Costs, Flow Sheet No. 1

Heads, 27.6 Yen

Extraction	Per Cent
Amalgamation	20
Sand leaching, 80 per cent (70 per cent sand in pulp)	44.8
Slime, 60 per cent (30 per cent slime in pulp)	14.4
Total	79.2
Cost per metric ton crushed, yen:	
Milling	2.15
Sand treatment	1.88
Slime treatment	1.56
Total	5.59
Valuable metals recovered, 0.792 x 27.6, yen	21.78
Cost, yen	5.59
Profit, per metric ton crushed, yen	16.19

The Nurupi mill and cyanide plant

It is peculiar that only 60 per cent of the gold and silver could be recovered in the slime treatment, when 80 per cent was recovered in leaching the sand. The reason for this was the presence of graphite, with its reducing action, precipitating the gold after it was dissolved. Only by removing the graphite before treatment could the extraction be improved.[1] Further, it

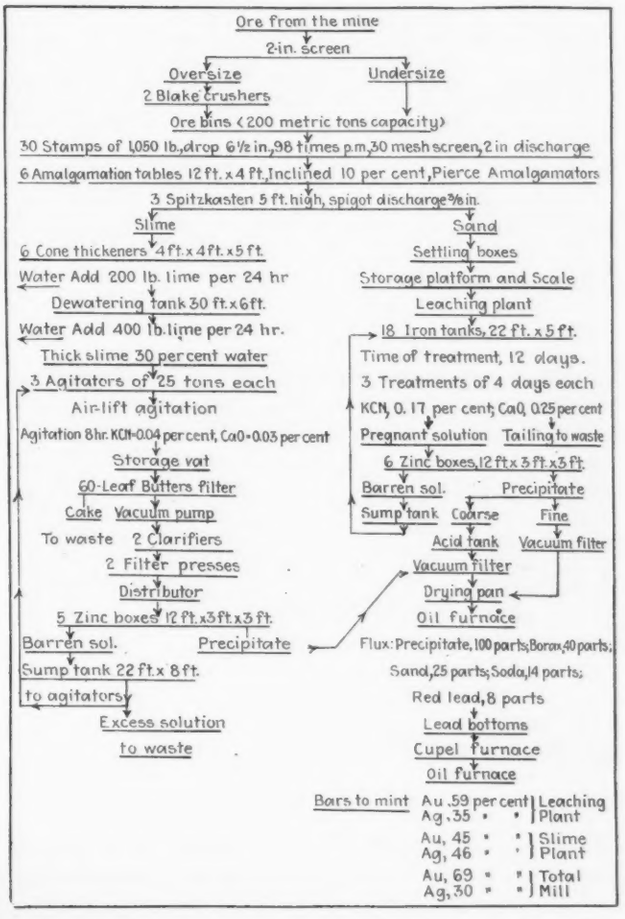

Ore from the mine
2-in. screen
Oversize
Undersize
2 Blake crushers
Ore bins (200 metric tons capacity)
30 Stamps of 1,050 lb., drop 6½ in., 98 times p.m., 30 mesh screen, 2 in discharge
6 Amalgamation tables 12 ft. x 4 ft., Inclined 10 per cent, Pierce Amalgamators
3 Spitzkasten 5 ft. high, spigot discharge ⅜ in.
Slime
Sand
6 Cone thickeners 4 ft. x 4 ft. x 5 ft.
Settling boxes
Water Add 200 lb. lime per 24 hr
Storage platform and Scale
Dewatering tank 30 ft. x 6 ft.
Leaching plant
Water Add 400 lb. lime per 24 hr.
18 Iron tanks, 22 ft. x 5 ft.
Thick slime 30 per cent water
Time of treatment, 12 days.
3 Agitators of 25 tons each
3 Treatments of 4 days each
Air-lift agitation
KCN, 0.17 per cent; CaO, 0.25 per cent
Agitation 8 hr. KCN-0.04 per cent, CaO-0.03 per cent
Pregnant solution
Tailing to waste
Storage vat
6 Zinc boxes, 12 ft. x 3 ft. x 3 ft.
60-Leaf Butters filter
Barren sol.
Precipitate
Cake
Vacuum pump
Sump tank
Coarse
Fine
To waste
2 Clarifiers
Acid tank
Vacuum filter
2 Filter presses
Vacuum filter
Distributor
Drying pan
5 Zinc boxes 12 ft. x 3 ft. x 3 ft.
Oil furnace
Barren sol.
Precipitate
Flux: Precipitate, 100 parts; Borax, 40 parts; Sand, 25 parts; Soda, 14 parts; Red lead, 8 parts
Sump tank 22 ft. x 8 ft.
to agitators
Lead bottoms
Excess solution to waste
Cupel furnace
Oil furnace
Bars to mint
Au .59 per cent, Ag .35 " " Leaching Plant
Au, 45 " " Ag, 46 " " Slime Plant
Au, 69 " " Ag, 30 " " Total Mill

Fig. 1—Flow sheet No. 1. 1915-1920, 100-ton mill

was observed that when the precious-metal content of the slime was lower, the tailing did not drop proportionally, but kept almost constant for head variations from 5 to 7 yen; thus, the lower the heads, the lower the percentage of extraction.

In the fall of 1920 the mill was reorganized to treat a lower-grade ore and the tonnage was increased to maintain the same gold output. It was decided to put in fifty stamps, which necessitated only a slight increase in the labor requirements. The foreign staff was actually reduced, so that there was a decrease of 46.5

[1]This problem has been solved at the McIntyre-Porcupine mines by treating the pulp, in the ball mill, with a small quantity of oil, which coats the graphite particles and makes them inert in the succeeding cyanide treatment.—THE EDITOR.

per cent in the labor cost per ton crushed. The capacity of the plant with the fifty stamps was found to be 5,700 metric tons per month.

For the treatment of the sand, it was decided not to increase the capacity of the leaching plant, but to eliminate a certain amount of tailing by table concentration.[2]

Slime treatment offered considerable difficulty; the extraction was never satisfactory, and there was reason to believe that with lower heads it would be worse. About half of the precious metals present in the heads appear in the slime. The extraction and cost of the two methods of treatment were found to compare as follows:

Flow Sheet No. 1

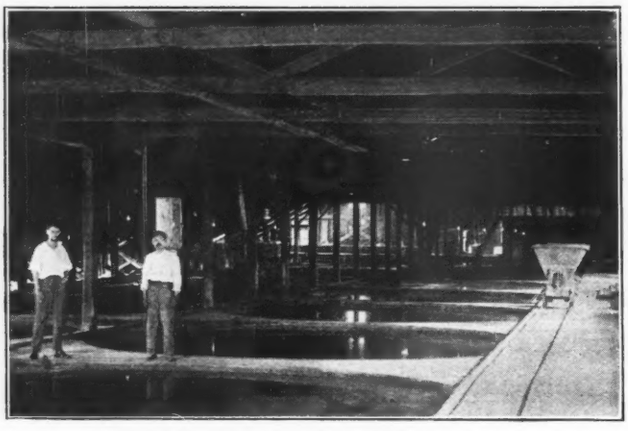
Slime heads, 14 yen

Extraction, 60 per cent, or 8.40; residue, 5.60 yen.
Cost per metric ton of dry slime, 5.20 yen.
Profit per metric ton, 3.20 yen.

New mill heads adopted, 20 yen; slime heads expected, yen	10.00
Residues, expected to be constant, yen	5.60
Extraction, yen	4.40
Treatment cost, per metric ton, yen	5.20
Loss per metric ton, yen	0.80

This was not at all encouraging, especially when the capacity of the plant was to be doubled, so I looked for an entirely new method of treatment.

It was decided first to open the battery screens as much as possible consistent with the freeing of all gold-carrying minerals from the gangue. Second, to remove all interfering impurities, such as graphite, by canvas table concentration of the slime. Third, to secure a prolonged cyanide treatment of the slime concentrate, by mixing it with the sand concentrate before



The leaching tanks

leaching.[3] Following these ideas, flow sheet No. 2 was designed, and after a shutdown of six months for reconstructing the mill, operations were resumed in May, 1921.

Characteristics of the New Method of Treatment

Slime heads, 10.00 yen.
Canvas table recovery, 71 per cent, or 7.10 yen.
Extraction by leaching, 90.7 per cent; total recovery, 6.44 yen.
Over-all extraction, 64.4 per cent.

Cost of table concentration per metric ton of dry slime, yen	0.66
Aliquot cyanidation cost per metric ton of dry slime, yen	1.00
Total cost of treatment per metric ton of dry slime, yen	1.66
Total recovery per metric ton of dry slime, yen	6.44
Total cost per metric ton of dry slime, yen	1.66
Profit per metric ton of dry slime, yen	4.78

It is to be noted that the extraction increased from 60 to 64.4 per cent while the cost decreased from 5.20 yen per metric ton of dry slime to 1.66 yen.

[2]See "Concentration and Cyanidation. *Mining & Scientific Press*, Dec. 3, 1921.
[3]"Cyanidation of Coarse and Fine Concentrates," *Engineering and Mining Journal-Press*, Sept. 9, 1922.

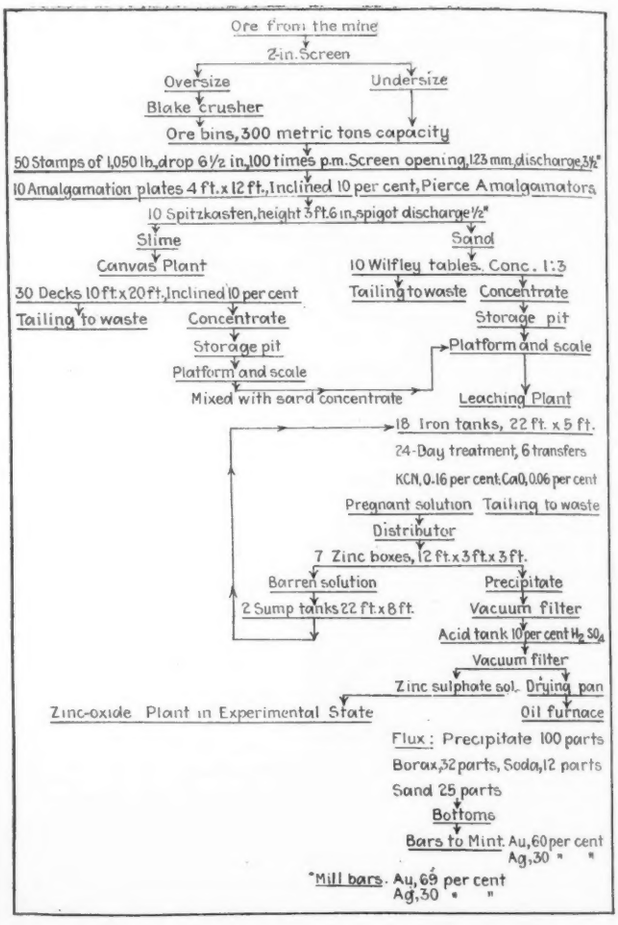

Ore from the mine
2-in. Screen
Oversize
Undersize
Blake crusher
Ore bins, 300 metric tons capacity
50 Stamps of 1,050 lb., drop 6½ in., 100 times p.m. Screen opening, 123 mm., discharge 3½"
10 Amalgamation plates 4 ft. x 12 ft., Inclined 10 per cent, Pierce Amalgamators
10 Spitzkasten, height 3 ft. 6 in., spigot discharge ½"
Slime
Sand
Canvas Plant
10 Wilfley tables. Conc. 1:3
30 Decks 10 ft. x 20 ft., Inclined 10 per cent
Tailing to waste
Concentrate
Tailing to waste
Concentrate
Storage pit
Storage pit
Platform and scale
Platform and scale
Mixed with sand concentrate
Leaching Plant
18 Iron tanks, 22 ft. x 5 ft.
24-Day treatment, 6 transfers
KCN, 0.16 per cent. CaO, 0.06 per cent
Pregnant solution
Tailing to waste
Distributor
7 Zinc boxes, 12 ft. x 3 ft. x 3 ft.
Barren solution
Precipitate
2 Sump tanks 22 ft. x 8 ft.
Vacuum filter
Acid tank 10 per cent H_2SO_4
Vacuum filter
Zinc sulphate sol.
Drying pan
Zinc-oxide Plant in Experimental State
Oil furnace
Flux: Precipitate 100 parts
Borax, 32 parts, Soda, 12 parts
Sand 25 parts
Bottoms
Bars to Mint: Au, 60 per cent
Ag, 30 " "
*Mill bars: Au, 69 per cent
Ag, 30 " "

Fig. 2—Flow sheet No. 2, 200-ton mill

The operating results of the new method of treatment are as follows:

Percentage of Recovery

Amalgamation	17
Concentration	85
Cyanidation	88
General recovery	81

Costs

Milling, including concentration, yen	1.42
Cyanidation of sand and slime, yen	1.83
Total cost per metric ton crushed, yen	3.25

This compares with a previous cost of 5.69 yen, the present figure being only 57 per cent of the former cost.

The alterations made in the flow sheet resulted principally in treating the ore more economically. The general recovery kept almost constant, although considerable improvements were made as far as cyanidation is concerned. In the treatment of slime, it is demonstrated that even with the sacrifice of 30 per cent of the valuable metals that occurs in concentration, the selection of a more suitable method of leaching improves the extraction and lowers the cost.

Canadian Graphite Comes to United States

The Black Donald Graphite Co., operating a mine and mill at Whitefish Lake, near Calabogie, Renfrew County, Ontario, during the year 1922 treated 1,700 tons of crude ore. No ore was mined. Of the total shipments, 95 tons was flake, and 531 tons was dust, the total value being $34,124. According to the Minister of Mines, exports to the United States totaled 488 tons, and 138 tons was shipped to Canadian points.

THE PETROLEUM INDUSTRY

Oil-Field Sampling

A Discussion of Methods and Equipment Employed—Coring Devices Preferred—Carelessness on Part of Drillers Often Results in Trouble

BY ERNEST R. LILLEY

UNTIL the last few years the subject of oil-field drilling received little attention from engineers. In fact, the value of the petroleum engineer is only beginning to be recognized by producers. Until the demand for gasoline brought higher prices for crude and a steady demand for increased production of oil, the bulk of the domestic supply of petroleum was produced by small operators, the large refining interests depending upon them for their supplies of crude. Usually the small operator did not drill his own wells but had them drilled under contract, the contractor being paid on the footage basis, with allowances for time lost in running casing and in fishing for tools. Except while drilling in, the contractor was rarely paid by the day. As the contractor paid his men by the day, his profit depended upon the number of feet drilled during a tower. Anything which tended to slow up drilling, such as the taking of formation samples, or the testing of slight oil shows, meant only delay and the loss of profit to him. His motto was and is today, "The most holes in the shortest time."

CONTRACT SYSTEM UNSATISFACTORY

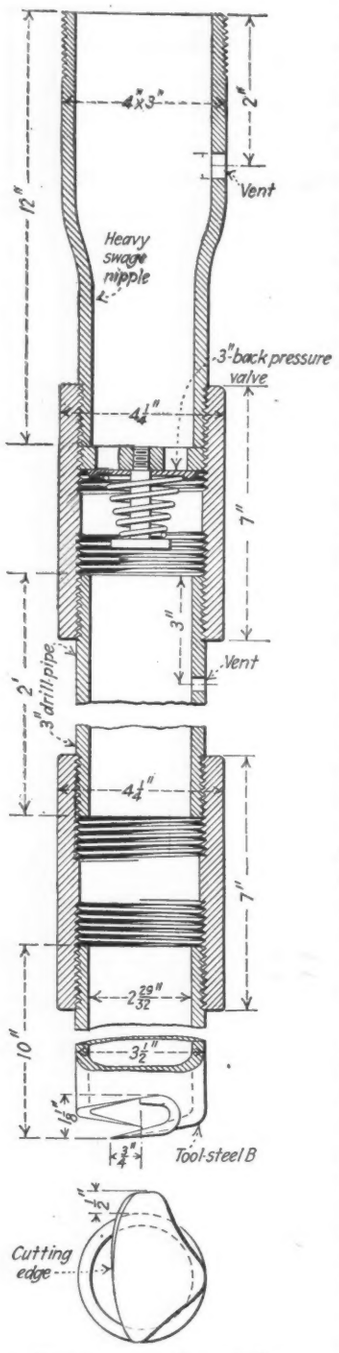
Such a system is not conducive to accurate recording of formations passed through, and has occasionally resulted in the passing up of sands which were later found to have been oil bearing and of commercial value. One of the most glaring examples of this type that has come to my attention is that of a well drilled by the Gladstone Oil & Gas Co. in the spring of 1918 near Walters, Cotton County, Okla. The well was drilled with rotary equipment and was finally abandoned as dry. A year later the Chapman well, a quarter of a mile to the south, came in making 450 bbl. of oil a day and considerable gas. The casing in the abandoned Gladstone well was ripped for a few inches at a depth corresponding to that of the producing sand in the Chapman well, the result being 75 bbl. of oil and approximately 35,000,000 cu.ft. of gas a day.

Instances such as this are, fortunately, not common even in rotary country. Many difficulties are, however, constantly arising in both rotary and standard country in handling production and in controlling wells because of the lack of accurate well logs and the total absence of samples. Perhaps the most important factor in making problems for the production manager or engineer is the failure of the driller to interpret correctly the nature of the sediment passed through, and, as a result, to supply the information absolutely essential for the proper setting of casing, for control of water, of gas at high pressures, and of flush oil production.

The inaccurate setting and cementing of casing may not only fail to shut off an upper water sand completely, but may leave an opening into the hole of sufficient size to permit the water to flood the hole and the oil sand below. An incident from my experience will indicate the nature of the problems arising in connection with the handling of gas wells. The well in question was drilled in a section in Eastland County, Tex., where no production was expected above 3,000 ft. The policy of the drillers in the section was to guess at or "fudge" the records to a depth of 2,000 ft. At a depth of approximately 1,900 ft. the drillers went unexpectedly into a bed of sandstone saturated with gas. The pressure was so heavy that the well drilled itself in and in a short time was giving an uncontrolled flow of 30,000,000 ft. of gas a day. Further drilling was, of course, out of the question until the gas pressure was reduced or the sand sealed off. When it was decided that the best thing possible would be to set a string of casing to the top of the gas sand and cap the hole until the gas could be sold, it was found that there were several hundred feet of open hole and that the log was totally unreliable. Four separate attempts to set the casing were made, but each effort failed, the gas working its way up between the pipe and the caving walls of the hole. Success was finally attained by the use of a specially designed packer and a lucky setting of the same in a relatively hard section, but not until after several hundred million feet of gas had been lost and thousands of dollars wasted in unsuccessful attempts to gain control over the well.

GOOD WELLS FREQUENTLY RUINED

It might therefore be inferred that the driller's negligence is the sole cause of the lack of accurate records and the various difficulties resulting. Such is far from being the fact. Many errors in the handling of wells are directly traceable to the lack of understanding on the part of the technically trained engineer of the meaning of many terms used by drillers which have localized meanings. More often wells are ruined because the methods of securing the needed information are too crude to give the necessary accuracy. The case of a well drilled in Creek County, Okla., is typical of hundreds of others all over the country. In drilling in the well, the driller, working under the direction of the production manager, after drilling through a number of

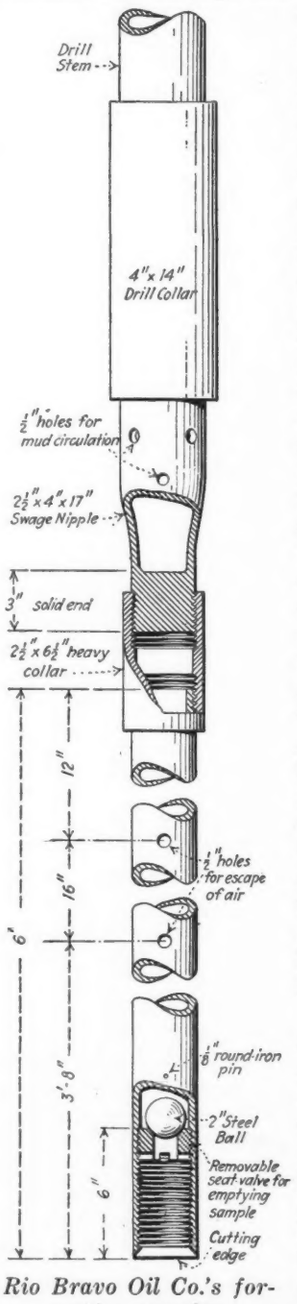


Auger sample, Gulf model, for sampling soft formations.

feet of rich oil sand, drilled into water in the lower part of the same sand. He had proceeded with the utmost caution, withdrawing his bit and taking samples with the bailer at frequent intervals. The first indication given that the water sand had been penetrated was the change in the "feel" of the tools as they drilled in a hole rapidly filling up with water. The agitation of sand cuttings and oil by the churning motion of the tools had made from a pure white brine-saturated sandstone an oil-soaked sand which gave an entirely erroneous impression. If, instead of drilling with the regular standard drilling tools, and thus reducing the rock to a powder, some device had been available by which cores of the sandstone penetrated might have been secured, the change from oil-bearing to water-bearing sandstone would have been noted immediately.

Until the development within the last three years of special sampling devices, logs of rotary-drilled wells were generally considered of little or no value, the standard or cable driller frequently taunting the rotary worker with his inability to tell what he was drilling through. So general had the idea become that the rotary was of little value except for making hole, that several states passed regulations making it mandatory that wells in certain sections be drilled in by cable methods only. Yet the standard driller has really little to boast of as far as sampling ability is concerned. The rows of 2-oz. sample bottles in the office of the geologist or engineer labeled to show formations passed through, together with depths, thickness, and other points of interest, are beautiful for show purposes, but so frequently does the series from offsetting wells differ in so many points that one is compelled to ask wherein the vaunted accuracy lies. Closer examination of the samples shows that in few instances has the bailer brought up anything larger than a sand grain. Occasionally, it is true, a piece of considerable size will stick to the bit as it is removed, but such samples are not often obtained. If the bailer samples are not selected carefully they may contain cavings from the walls of the hole in sufficient quantity to make the sample valueless as a record of material drilled through. As the driller's log is usually as brief a record as he can make it, the various points, such as ease of drilling, smoothness of bit when withdrawn from the hole, and other similar items which might aid in determining the nature of the caving and sample mixture, are not available. Imagine the problem faced by the engineer who is called upon to reset a string of casing at a depth where the drillers' log shows a number of feet of sandstone and his samples a pure clay!

Far greater accuracy can be secured in his records by the conscientious cable driller than by the rotary driller without the use of coring devices. Where the string of tools must be pulled every few feet in cable drilling to remove the cuttings and sharpen the bit, the heavy cumbersome rotary tools may not be pulled for over 100 feet. Samples cannot be secured at regular intervals by running a bailer. Everything now depends upon the "feel" of the drilling tools and the proper correlation of samples brought to the surface by the mud fluid with these changes noted in drilling. Most experienced rotary drillers are able to tell from the action of the drill when changes in the formation being drilled occur. Thus, shale drills smoothly and rapidly; sand drills slowly and wears the bit rapidly; hard limestones cause the drill to catch and jump; and gumbo causes the bit to "ball up" and makes it necessary to stop and spud. As the driller usually works with a notched or chiseled grief stem or Kelly joint, he can immediately make a notation on his log whenever there is a change in formation. Such records of depths are considerably more accurate than those secured by the cable unless he runs a special measuring line.



Rio Bravo Oil Co.'s formation sampler.

The problem of securing the sample itself is, however, more complicated, and it is at this point that the inaccuracy of this type of record becomes most glaring. The sample must be brought to the surface by the mud fluid used to hold up the walls of the hole, through the space between the outside of the

drilling stem and the open walls of the hole. If the hole caves slightly, the products of this caving are added to the mixture of mud fluid and bit cuttings and brought to the surface as a triple mixture, from which even the most expert can hardly separate the good from the worthless. Moreover, if the hole has been widened by caving, the time elapsing between that at which the formation was drilled into and at which it reaches the surface is considerably greater than it would be if the hole had kept its original diameter. In fact, the time interval is constantly changing in a perfect hole, as with increased depth the time taken by the cuttings in reaching the surface is lengthened. The accuracy of correlation depends solely upon the skill and care of the driller or sampler or both. In a great number of cases it is believed that factors tending to cause a lag in the upward movement of the drill cuttings will be largely neutralized by factors tending to a more rapid movement such as the slight decrease in amount of space between drill stem and walls of the open hole due to the greater displacement of the drill pipe collars. In such cases the following formula will probably prove sufficiently accurate for common use in the calculation of time taken by the cuttings in reaching the surface:

$$N = \frac{D \times (R^2 - r^2) \times 100}{X \times Y \times Z \times E}$$ in which

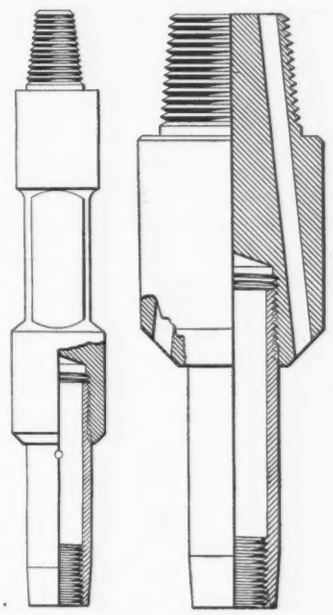
N is number of minutes taken by the cuttings in moving from bottom of the hole to the surface.
R, radius of drilled hole ($\frac{1}{2}$ diameter).
r, radius of outside of drill stem.
D, depth of the hole in inches.
X, radius of pump cylinder.
Y, length of stroke of pump.
Z, number of pump impulses per minute—in duplex pumps this would be twice the number of strokes.
E, per cent efficiency of the pump.

By the use of this formula it could be determined easily and rapidly that the cuttings made in a hole 2,500 ft. in depth and 6 in. in diameter by a bit attached to a 3-in. 12-lb. drill stem (actual outside diameter 3½ in.) would be brought up by a 5¾x12-in. duplex pump running at seventy strokes per minute with 60 per cent efficiency in a little more than twenty-one minutes. As the only variable in the formula is the depth of the hole for any given diameter of stem and hole and speed of the pump, it is an easy matter for the engineer to have a series of graphs prepared in the office, from which the time intervals may be read off directly in the field. John R. Suman, production engineer for the Rio Bravo Oil Co., shows a number of such charts in his book, "Petroleum Production Methods."

Few Percussion Core Drills

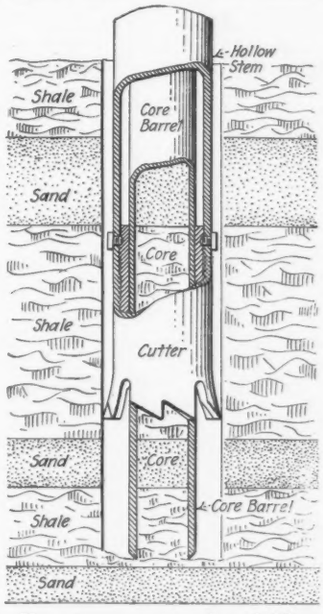
During the last three years numerous attempts have been made by production engineers and drilling machinery manufacturers and dealers to design coring and sampling devices which would give better indications of the nature of the sediments penetrated. Two distinct tendencies may be noted in the efforts of the designers. On one side is a group who prefer a device to give small samples and to be used in conjunction with ordinary drilling tools; others are striving for an instrument which will not only take a core but also make hole. Of the several types developed by the latter, the best known is the large-size diamond drill with which a number of wells have been completed in the last few months. The action of this drill in oil-field work I described in the *Engineering and Mining Journal-Press* of July 22, 1922. This is in reality a special type of rotary drill.

Only two devices for securing cores with cable equipment have come to my attention. Of these, the "Ideal" core extractor, made by the Union Tool Co., is the simpler. It is designed to take cores of from 6 to 12 in., the length depending on the size of core holder or sleeve used. The core sleeve threads into the head, which is screwed into the drill stem in place of the ordinary drilling bit. Holes at the top of the sleeve allow the mud to pass out and wickers on the cutting end of the sleeve serve to retain the hard-packed core while it is being withdrawn from the hole. In taking core the tools are jarred loose by a slight upward movement of the cable and allowed to fall back several times until a sufficient amount of core is secured. The core is usually fractured considerably by the force of the concussion and loses some of its original characteristics, such as degree of porosity. The device does, however, give a small, easily removed sample, and causes only a slight delay in the regular drilling. In the hands of experienced operators the samples secured should give valuable aid in drilling in or casing operations.



"Ideal" core extractors. Left, for use with standard tools. Right, for use with rotary tools.

It will be noted that the Ideal is not a drilling tool and that after one core has been taken the tools must be run to bring the hole to full size again. The "Keystone" percussion drill, manufactured by the Keystone Driller Co., not only takes cores but also maintains the diameter of the hole. This tool was designed primarily for the testing of bituminous coal beds. The core drill, about 14 ft. long, consists of a toothed cutter attached to a hollow drill stem or pipe, which in turn screws into the lower end of drilling jars of the ordinary standard type. The core barrel widens at the upper end to the same diameter as that of the inside of the stem, so that when the



Keystone percussion drill taking core.

cutter is screwed into place the barrel canot slide out as the tool is raised or lowered into the hole. The protective action of the core barrel is clearly shown in the cut. Twenty to thirty inches of core are taken out at one run, and unless the material is unusually friable it will probably be necessary to jar the core loose. As no special catching device is used, there is considerable danger of loosening the core at this point.

Samples Possible in Soft Rotary Rocks

In view of the differences in the nature of the samples secured, rotary samplers might well be divided into those in which an effort is made to secure the rock unbroken or only slightly broken and those in which broken fragments are recovered. Though the greater number of patented devices are designed to recover cores, it must be realized that in many soft formations their recovery is practically impossible, because of the ease with which they disintegrate. Of the devices used for the recovery of broken-up samples, probably the best known is the auger type of barrel. As used by the Mexican Eagle Corporation in Mexico it consists of a section of steel pipe usually of from 3 to 4 in. in diameter, and of variable length, attached to drill pipe of the same size or to pipe of somewhat greater diameter by means of a heavy swage nipple. The tool is made by cutting and bending a lip over the bottom of the piece of pipe. The lip acts as a cutting blade and also prevents the downward movement of the sample lodged in the barrel when the pipe is raised.

Before the sample is made, the hole should be thoroughly flushed to remove all previous cuttings or drilling mud that might have settled to the bottom. During the sampling operation no pump circulation is permitted, lest the cuttings be washed out of the barrel. A model similar to this one, except for the addition of a back-pressure valve between the swage nipple and the barrel, is used extensively in the Gulf Coast territory today. In the Gulf model, drilling water is circulated throughout the run, the back-pressure valve acting to shut off the water from the sample in the barrel and forcing the fluid out into the open hole through the vent shown in the cut, thus flushing away the cuttings not taken into the barrel. See page 582 for detail.

Samples of the same nature are recovered by the Rio Bravo Oil Co., using a totally different type of barrel. This sampler is of the non-reaming type and is attached to the end of the drilling pipe by means of a swage nipple in the cut. The nipple is provided with a number of holes for mud circulation, and its lower half is made solid, to prevent the entrance of any of the mud fluid into the barrel. The barrel is usually 6 ft. long, and consists of a short lower section, and a long upper section into which the core is forced. As the tool goes into action after the hole has been flushed, the cutting edge begins to cut downward, forcing the core into the lower section and past a ball valve, where its disintegration is completed and finally imprisoned as a reconsolidated mass in the upper section of the barrel. As the sampler is pulled upward, the ball, which has been held in place by the iron pin, reseats itself. In this and in the auger samplers the cuttings are removed by unscrewing the barrel and pushing the sample out. See page 582.

As the samples given by the different devices mentioned are in no way indicative of the physical character of the rock penetrated as a whole, it is natural that the major development should be in the perfection of devices that will give cores instead of broken samples. It is now almost universal practice in the Gulf Coast fields to take cores, whenever they are desired, with a core barrel made in the field from a joint of common pipe. For use in soft formations the lower end of the pipe is cut into a number of wedge-shaped fingers, forming what is known as a basket. The number of these fingers or teeth varies from four to sixteen, according to the size of the pipe, the larger number being used on 8-in. and the smaller on 3- and 4-in. pipe. The teeth are cut out with an ordinary hacksaw and are alternately bent in or out slightly, those bent out cutting a hole somewhat larger than the outside diameter of the pipe, thus facilitating the taking of a longer core by providing a clearance around the pipe through which the mud fluid may circulate. The inner teeth, making a core of smaller diameter than the pipe, prevent to a considerable extent the wedging and jamming of the core in the barrel and the resultant alteration of the core. The core barrel in common use varies from 6 to 10 ft. in length, although longer barrels have been used successfully. In the upper section of the barrel a small hole is drilled to permit circulation of the mud fluid during operation.

As the basket core barrel is run into the hole it becomes filled with mud from the hole and cuttings from the wall. It is therefore necessary to run the pumps vigorously for fifteen minutes after the barrel reaches the bottom, to clean out the inside of the barrel and to wash out any loose material from the bottom of the hole. The pumps are then slowed down, and the barrel is rotated at the rate of 15 to 20 r.p.m. and fed downward slowly. As soon as sufficient core has been taken, usually 3 to 5 ft., the core barrel fingers are closed in by increasing the weight on the pipe while still rotating, and the pipe is pulled out of the hole, the bent fingers serving as a basket to retain the core, while the small hole in the upper section of the joint permits the escape of the drilling fluid.

The extraction of the core at the surface is accomplished by cutting off the lower end of the barrel with a hacksaw or acetylene torch, unscrewing the joint and pushing out the core. The successful recovery of cores depends largely upon the water circulation, the weight on the pipe while coring, and the closing of the fingers. Failure of the fingers to form a good basket is frequently the cause of washing out the core while pulling. Probably, in the case of a large number of lost cores, the clogging of the water hole is the direct cause of the loss through the pressure of the imprisoned mud fluid.

Too much must not be expected of the core. In many cases its value is extremely doubtful. As a means of determining the content of a sand, whether it is oil bearing or not, it is of value only when it gives a positive test, as the negative test may mean that the oil has been leached out of the sand and not that it is not oil bearing. The nature of the bed penetrated is generally well brought out by the core sample, but it is not uncommon to find the lower portion of a core turned to a fused mass and the barrel itself completely distorted. As the cutting portion of the barrel has only limited access to the drilling mud after the first few inches of drilling, the slightest increase in the rate of revolving the pipe, or a slight excess of weight upon the pipe, is often the cause of overheating and slagging.

The "Ideal" rotary core extractor, designed to take

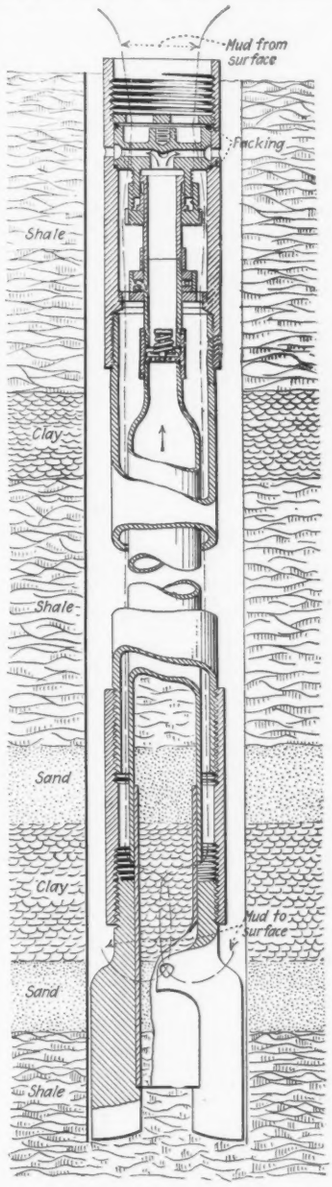
cores up to 1 ft. in length in the same way as the standard model does, is able to overcome some of the objections raised against the basket type. The rotary model is provided with two holes in the top of the sleeve for the passage of water. The tool is attached to the drill pipe and lowered to within a few inches of the bottom of the hole, and the pumps are turned on to flush out the hole. The extractor is then lowered to the bottom of the hole and the full weight of the pipe allowed to rest upon it, the weight being sufficient to force the sleeve into the soft rock. In hard formations the pipe may be dropped from 6 to 8 in. before the sleeve is able to penetrate the rock. The wickers at the cutting end act as retainers in pulling the core. The most serious objection to this type of device is that the length of core secured is not commensurate with the loss of time in securing it.

New Device Promising

Recently, the Hughes Tool Co. placed upon the market a basket type of barrel with a patented check valve which is designed to prevent slagging and washing out of cores. According to information given to me by H. W. Fletcher, engineer for the company, it consists of a coupling with a restricted passage in the center and which is used to attach the core barrel to the lower end of the drill pipe. The hole near the upper end of the core barrel is omitted and a hole is provided in the side of the coupling just above the restriction. The core barrel is run into the hole in the ordinary way and is cleaned out by running the pumps when it has reached bottom. Then a steel ball is thrown into the drill pipe and pumped down until it seats in the restricted opening in the coupling, where it seals off the core barrel from the flushing mud, which passes out through the small hole just above the seat and returns to the surface. As the coring progresses, the flushing mud which fills the core barrel is displaced and forced to travel down alongside the core and up along the outside of the core barrel, keeping these surfaces lubricated and preventing burning, the valve being held shut by the heavy pressure on the fluid above. When the core is complete and the barrel is withdrawn from the hole, the steel ball prevents the flushing mud inside of the drill pipe from washing down through the core barrel and destroying the core. Though the device has been used in a large number of cases successfully, its action has not yet been proved under all conditions.

A device similar in action to the basket type is the adamantine or chilled-shot core barrel, a tool which has been carried by oil-well supply houses for a number of years, but which has not met with favor in the opinion of the average oil man. The barrel, a length of pipe with special grooves to feed the shot, is attached to the drill pipe directly or by means of a swaged nipple. In operation, the barrel is lowered to the bottom of the hole and the hole cleaned out thoroughly by flushing. The barrel is then raised slightly off bottom and several pounds of shot are run into the hole. The pipe is allowed to rest lightly upon the shot, the pumps connected to the drill pipe, and the rotary is started up. After the core has been made, it can be wedged into the barrel by injecting coarse sand into the circulating system. This causes the core to freeze tight to the barrel and makes its removal possible. Though loss of cores and other troubles common in coring with the basket type are avoided, the failure to retain the shot in a working position in water sands and the rapid loss of shot in soft shales through imbedding them has made this tool of doubtful value for ordinary work. As used today by oil men, the shot drill barrel is restricted to drilling in hard, dry formations where the ordinary fishtail bit fails to make headway.

In actual use, all of the devices discussed so far, with the exception of the shot drill as used in California, are non-reaming devices—that is, they do not drill a hole of as great a diameter as that drilled by the fishtail that they replace. It is therefore necessary to redrill all cored sections before the hole can be extended downward for any appreciable distance. The distinction between reaming and non-reaming devices has been stressed by a number of engineers, but the differences in action appear to be due to mechanical difficulty of extracting large cores and not to basic differences in the theories upon which their construction has been based. The "Ideal" is a typical non-reaming type, but there is no reason why, with slight alteration in its construction, it could not drill a full-size hole while coring in small holes.



Knapp fishtail core barrel taking core

In the most complicated group of devices now on the market an attempt is made to solve this difficulty by making a barrel which cuts a full-size hole and at the same time yields a small-diameter core. A number of these instruments have been tried out, and, though all have proved partly successful, none have, as far as I know, entirely met the expectations of their inventors. The first of the group was merely a hollow fishtail bit attached to the end of the drill pipe in place of the ordinary bit. It failed to give satisfactory results, the cores being broken by the rotary movement and washed out by the mud fluid. Though the devices growing out of this crude one differ in detail, the basic ideas in all are the same, and the following description is representative of all:

The barrel in the Knapp model is of the double type, having an inner and an outer shell. To the top of the inner barrel, which takes the core, is attached a pressure valve, which serves to keep out the mud fluid and

as an escape for the mud contained in the barrel when the operation begins. The space between the two pipes is utilized as a waterway, and through it during operation the drilling fluid is forced. The cutting edge is a fishtail bit arranged to cut a core slightly smaller than the inside diameter of the inner pipe. In operation the inner barrel slides down over the core as the drilling proceeds, thus protecting it from destruction. The core is held in position while pulling by its tightly packed condition. Except for the lack of the ring valve used by the diamond-drill manufacturers to retain the sample while pulling, the device differs only in minor details from the double-core barrel used in testing coal and other friable rocks with the diamond bit.

In the Oilfields-Holland model used by the Shell company in California, the fishtail bit is replaced by a crown bit with six cutters, all facing outward. To further the recovery of the core, a core catcher, in the form of a tapered ring, is inserted above the bit. In principle, the core catcher should release itself with the slightest downward movement of the core, but as the catcher frequently becomes jammed by grit, this action cannot be relied upon. The device does, however, make a better core and serves to retain hard-rock cores better than the simpler Knapp barrel. Recently, an intermediate model, the Acme, has come into use in the Gulf fields in a small way. In this a bit resembling the fishtail is retained while a ring core catcher is introduced.

Much is expected of a type put out by the Reed Roller Bit Co. known as the Reed and Helper coring tool. In this tool, a four-toothed bit is used, and the catching device consists of four blades suspended upon pins so as to bear directly upon the core with the slightest downward movement. The most noticeable innovations, however, are a special arrangement of the valves to facilitate the movement of the core into the barrel, and a plug screwed into the bottom of the barrel to keep it clean while lowering into the hole. This is loosened and moves upward above the core during operation. The importance of such minor improvements as these cannot be overestimated. The Reed and Hepler tool may not fulfill the expectations of the engineers who designed it. That can be determined only by hundreds of field tests under all conditions, but it indicates the lines upon which the development of coring devices will proceed.

Petroleum Development in Africa in 1922

The presence of oil in Algeria was known many years ago, but commercial production, which amounted to 3,000 bbl. in 1921, dates back to 1914, when oil was brought in at Tiliouanet, according to a paper presented by H. C. Morris and David White at the recent meeting of the A.I.M.E. in New York. Nevertheless, it cannot be said that the results of exploration to date have in general been satisfactory. A valuable review of the geology of Algeria, with sketches and sections of local structure and stratigraphy and a general geologic map, has been published by Prof. Marius Dalloni, of the University of Alger.

The Egyptian government has become interested in prospecting for oil and is carrying on development work at Abu Durba and at Abu Shaar, in Egypt. Eight wells have been drilled in the former place. Oil was found at shallow depth and in small quantities in five of the bores. Geologists believe that there is an extensive oil pool here, and every effort will be made to tap it. At Abu Shaar, the government drillers had reached a depth of 1,200 ft. in an experimental well, but no oil has been found, according to the latest reports available. The Anglo-Egyptian Oilfields, Ltd., has continued its activity in the Hurghada field, and forty-four wells have been drilled, according to recent reports, twenty-six of them being producers.

In the Gemsa field, the Anglo-Egyptian Oilfields, Ltd., has sunk twenty-two wells to date, though all but six of them proved dry. Three of these have since run out, so that production is obtained from only three wells at present.

In Portuguese East Africa, the Anglo-Persian Oil Co. has for some time been prospecting for oil in the Territorio do Nyassa, governed by the Companhia do Nyassa. It is understood that this company obtained sole rights from the Companhia do Nyassa to prospect for oil within that company's territory on a guarantee of spending within the country £10,000 annually for not less than two years, and that sum for each year thereafter in which prospecting was carried on, plus a certain percentage to the company (Companhia do Nyassa) on the profits derived from oil if it should be found.

There have been rumors of oil indications near Mgagane, a station halfway between Biera and Chindio, on the Trans-Zambesia railway. Engineers of the Manica Trust prospecting in the neighborhood have located a syncline dome, which covers an area four by seven miles. They are now waiting to make definite tests with the drill.

A later report announces that an important deposit of oil has been discovered near the Trans-Zambesia railway. The report came through official sources from Mozambique, but no particulars are given.

Geological explorations in British Somaliland are reported to have brought to light encouraging indications of the presence of petroleum in the Gadabursi Mountains.

Oil indications in the northwest section of Madagascar and chiefly in the Mesozoic of the coast region have been fairly well covered with concessions. The Colonial Government is said to hold about 800 square miles and is reported to be planning the encouragement of exploration early this year.

In South Africa it is reported that the North-Western Cape Colony Prospecting Syndicate, which for twenty years has been intermittently boring for oil at Dubbledevlei, near Carnarvon, in the Cape Province, has finally gone into liquidation. This action was taken after an English expert had given his opinion that there is no indication of the presence of a petroleum field in that locality.

In Angola, the results of the exploration of the Sinclair concession (Companhia de Petroleo de Angola) are said to be distinctly reassuring. It will be remembered that the area covered is the northern part of the territory extending for about 600 miles along the African west coast, north of the Benguela railroad and west of the fifteenth meridian. In May, all that part of the colony not previously conceded was granted to the Companhia Mozambique, Ltd., in which British capital is said to be largely interested. The Mozambique company has organized the Companhia Concessions de Petroleo de Angola to do the active exploitation work.

Studies of the commercial possibilities of South African oil shale have been made in England with sufficiently encouraging results to justify the erection of a small plant in South Africa for further study.

USEFUL OPERATING IDEAS

Underground Orientation by Three-Wire Method

BY J. R. JAHN

Some time ago I worked up a quick orientation method for surface surveys using (a) signals spaced at equal intervals along a line, and (b) signals forming a right triangle. The same principle can be adapted to orientation from plumb lines in a vertical shaft and has superior qualities over two-wire methods. In the latter, the orientation may be accomplished by shifting into line between wires or by measuring two sides and the included angle of a triangle. In the former, the "pendulum" effect makes setting up difficult, and in the latter reliance must be placed on equal precision of linear measurements. This can be obviated by the three-wire method where underground measurement of distances to plumb wires is avoided. Two cases, (a) for multi-compartment, and (b) for single-compartment shafts are solved by the following methods:

CASE (a), FOR MULTI-COMPARTMENT SHAFTS

Three plumb wires are hung over a straight-edge at the shaft collar, with the middle wire equidistant from the end ones. The bearing of the line of the straight-edge is found from surface traverses or otherwise. The spacing of the wires should be as great as the shaft dimensions will permit. Underground, the transit may be set at any convenient point at the station, where the wires can be seen. A reference mark, such as a vertical pencil mark on white paper or a plumb line, should be established. The angle between this mark and each wire is then read as many times as will give the correct mean position of the wire. The mean of included angles as subtended by adjacent pairs of wires is found by addition or subtraction. Then the angle C between the line of sight to the mean position of the middle plumb wire and the straight-edge can be found by means of the formula cot $C = \frac{1}{2}$(cot A — cot B), where A is less than B and B is less than 90 deg. If B is greater than 90 deg. its cotangent is cot (180 deg. — B) and is negative, consequently the sum and not the difference is taken above. It should be noted that C is the angle on the "B" side of the middle plumb wire. The angle that the ray to the reference mark makes with the line of the straight-edge is found by adding or subtracting the angle between the rays to reference mark and to the mean position of the middle plumb wire, to the angle C, since an exterior angle of a triangle is equal to the sum of two opposite interior angles.

CASE (b), FOR SINGLE-COMPARTMENT SHAFTS

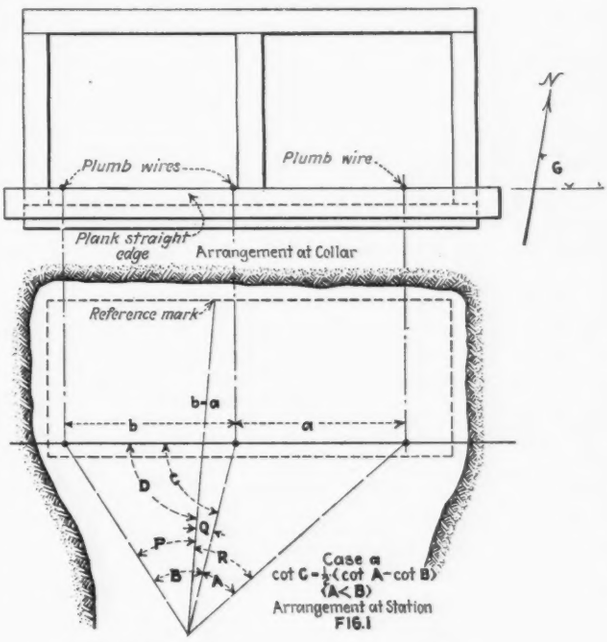
The wires should be hung over straight-edges forming a right angle, one at the vertex and one on each leg equidistant from the wire at the vertex. The mean angles subtended by adjacent pairs of the plumb wires are found by repeated readings as above described, and the angle between the ray to the mean position of plumb wire at the vertex and the line of the straight-edge opposite angle B is found by means of the formula

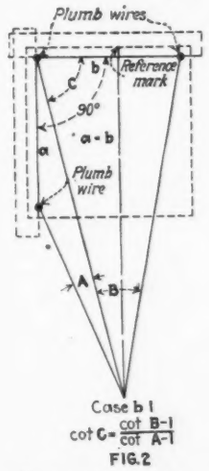
$$\text{Case (b) (1) } \cot C = \frac{\cot B - 1}{\cot A - 1}$$

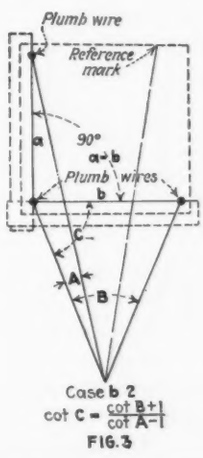
where transit point lies within the right angle; and,

$$\text{Case (b) (2) } \cot C = \frac{\cot B + 1}{\cot A - 1}$$

where B is measured from the back side of a leg of the triangle.







Illustrating the problem as worked out in multi-compartment and single-compartment shafts.

Having found the angle C, the co-ordinates of the transit point may be found either by trigonometry where one side (i.e., distance between middle and end plumb wire as measured at the collar) and two angles of a triangle are known, or by using the bearing of

the ray to the middle plumb wire and its mean distance. A high degree of precision is not required in this measurement. This solution is a special case of general "three-point problem" as discussed in *Engineering News-Record,* April 27, 1922, p. 684.

The two cases are shown in the accompanying illustrations.

Example: In Fig. 1 let $P = 41$ deg. 12 min.; $Q = 9$ deg. 38 min., and $R = 43$ deg. 22 min., and the bearing of the line of the straightedge be N. 78 deg. 54 min. E.

Then: $B = 50$ deg. 50 min. and $A = 33$ deg. 44 min.

$\text{Cot } C = \frac{1}{2}(1.49755 - 0.81461) = 0.34147$

$C = 71$ deg. 9 min.

$D = C + Q = 80$ deg. 47 min. and the bearing of the ray to the reference marks is $G - D$, or

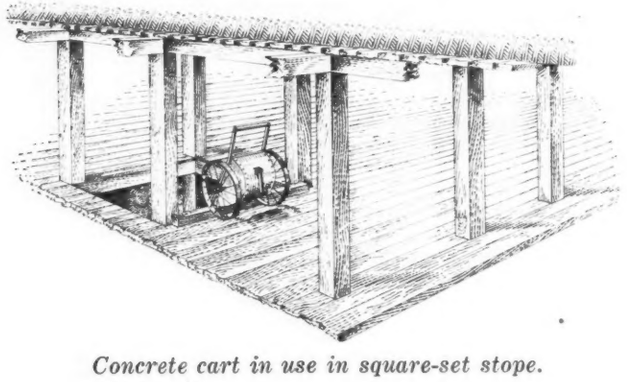
N. 78 deg. 54 min. E. — 80 deg. 47 min.

= N. 1 deg. 53 min. W.

Use of Concrete Carts in Square-Set Stopes

Movement of ore from the breaking faces to the ore-passes is accomplished in square-set stoping in a variety of ways. The simplest method is by shoveling and by the use of inclined chutes in conjunction with shoveling. This method reduces the proportion of hand labor to a minimum. Where square-set stopes extend beyond shoveling or chute distance from the ore-passes, tracks can be laid and ore cars used. In place of this method wheelbarrows are sometimes used. The wheelbarrow is not especially convenient. It has a volume capacity of from 3 to 4 cu.ft., and weighs from 62 to 100 lb., depending upon the thickness of metal used in its construction. Its greatest length is 67.5 in. (tubular steel wheelbarrow).

No specially convenient device appears to have been designed for this purpose. In a small mine where the orebody was irregular and the stope followed these irregularities on a horizontal plane to a considerable distance from the ore-pass, I found concrete carts being



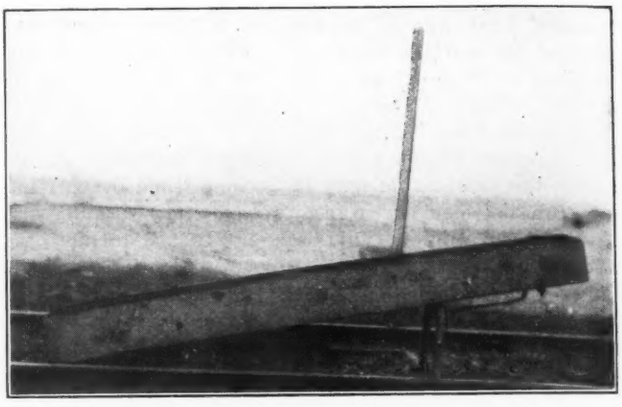
Concrete cart in use in square-set stope.

used to more or less advantage. The stopes were floored. The cart could be readily moved to different faces on the same floor. Such carts vary in size. One size has a wheel diameter of 42 in., a length at the top 38.5 in. (excluding the handle) and a 20-in. width of the body. The capacity is 6 cu.ft. and the weight 240 lb., or 40 lb. per cu.ft. of capacity (the weight of the steel wheelbarrow is from 21 to 30 lb. per cu.ft. of capacity). The weight of the loaded concrete cart is approximately balanced upon the axle and therefore requires little more effort than that required to push it empty over the floor. The large-diameter wheels reduce the tramming effort to a minimum. It is not inconveniently high for shoveling.

Simple Car Stop

By Cecil Rowe

In handling loaded cars down a 2 to 2½ per cent grade with a rope it occasionally happened that a workman would fail to fasten the rope securely and thus allow the cars to run into the horn dump, causing damage and delay. Though sprags were kept on hand, the average workman was unable to throw them into the spokes of the moving car wheels. The device here described and illustrated was then made and used with success:



Timber raised between rails to stop car

A piece of 4x6-in. timber was laid on the ties between the rails and hinged at one end. Under this was placed an iron rod, usually of ¾-in. round iron, with a U-shaped bend, as seen in the photograph. To one end of the rod was fastened a hand lever with a pawl attached to keep it in any position desired. At the point where the rod struck the timber, a ⅜-in. round iron guard was placed to keep the rod from moving too far.

Under normal operating conditions the timber rested level with the ties. If the haulage rope broke, however, the lever was thrown, raising the timber to an inclined position as shown, remaining in this position on account of the pawl. The car was thus brought to a stop without damage. The lever was then moved back to its normal position, allowing the car to come back on the rails again.

A Handy Press

By Charles Labbe

Around mine and mill a portable device is often required to force out gears, pulleys, frozen clutches, piston pins of gas engines, and the like, where the usual shop screw press cannot always be used. For this purpose I use a piece of hoisting cable about 10 ft. long (⅜ in. for light work and ⅝ in. for heavier work) with a screw jack, in the bottom of which I cut a shallow rounded groove. In this groove I fit a short piece of 1-in. pipe, through which the cable is passed and which keeps it in place. The cable is passed twice through the pipe around the end of the jack and about the gear or other object that it is desired to loosen, thus being used in a double sling. The two ends are fastened together with three cable clips. With the pressure of the jack, accompanied by light tapping on the 1-in. pipe, the gear is then readily loosened. The cable is preferable to chains, which do not stand strains so well.

CONSULTATION

The Use of Pulverized Coal in Smelting

"We have been thinking of the possibility of using some type of pulverized-coal equipment in the smelting of nickel ores in a cubilot, and we are taking the privilege of writing you for any information that you have upon the subject. We understand that some of the lead refiners are using pulverized-coal equipment to smelt lead ores, but we believe that this smelting is done in certain types of reverberatory lead furnaces and not in cubilots. Do you know of any company smelting in a cubilot and could you refer us to any data thereon?

"Will you please let us know if you have published in your magazine any articles along this line in the last few years? We have gone through our files of publications here, but cannot find anything pertaining to our problem.

"If you will please let us have the benefit of your advice on this subject we shall much appreciate it. Of course we should also be interested in any information you may have bearing upon the question of the use of this equipment in blast furnaces."

It is now common practice in copper smelting in reverberatory furnaces to use pulverized-coal firing; in fact, either pulverized coal or oil are used almost exclusively in this country, the old method of hand firing lump coal on grates being no longer used on many of the large furnaces. The use of pulverized coal in blast furnaces, however, has not been so extensively developed. It has been tried at one or two plants in this country and was partly successful at the plant of the Tennessee Copper Co., at Copperhill, Tenn., and also at the plant of the International Nickel Co., at Copper Cliff, Ont. It is also used at the new Cerro de Pasco smelter, and will no doubt be used at the Katanga plant, in the Belgian Congo. The U. S. Smelting, Refining & Mining Co., at Midvale, Utah, uses pulverized coal in the blast furnaces in lead smelting, and the American Smelting & Refining Co. is reported to have experimented with the use of this form of fuel in lead smelting. An extended article on the subject appeared in the Aug. 16, 1919, issue of *Engineering and Mining Journal*, and since then several briefer references have been made.

Metallic Tungsten Not Recovered From Old Electric Lights

"We would greatly appreciate your advising us what process is used in reclaiming and how to extract the tungsten from old burned-out electric bulbs."

We do not know of any method being used to recover the tungsten metal from burned electric-light bulbs and doubt whether it is done nowadays. We are informed by a large manufacturer of incandescent lights that scrap wire accumulated in the factories, where the manufacturer is perfectly sure of its tungsten content, is sometimes burned back to the oxide and repurified for use, but the filaments are not so used. This manufacturer knows of no case where the waste tungsten filaments from old lamps are recovered for use in making new filaments.

The Mineral Production of Southern Rhodesia

"I have been unable to obtain any statistics of the mineral production of Southern Rhodesia. I am particularly interested in the non-metallic production of mineral as well the metallic output. Are the 1922 figures available yet?"

The following table, which appeared in a recent issue of the *London Statist*, gives the metal and mineral production for January of this year. Rhodesia is one of the world's most important gold-producing countries. Its output of chrome ore and asbestos is a big factor in the markets for those two products; in fact, Rhodesian asbestos is a severe competitor of the Canadian grades.

Southern Rhodesia Mineral Output

	1921	1922	1923, Jan.
Gold, fine oz.	585,525	652,791	56,630
Silver, fine oz.	152,989	172,209	14,731
Copper, tons	3,080	3,388	278
Chrome ore, tons	50,188	93,474	14,750
Coal, tons	574,753	515,650	40,017
Asbestos, tons	19,529	14,249	1,708

In addition, 63 tons of arsenic, 12 tons of mica, and 26 carats of diamonds were produced.

Southern Zirconium and Titanium Deposits

The statements with reference to the marketing of zirconium and titanium contained in the March 3 issue of the *Journal-Press* have evoked the following interesting and supplementary comments from Mr. H. H. Buckman, who is operating one of the Florida deposits:

"The Buckman and Pritchard mineral deposits on the east coast of Florida were discovered and developed by the writer and his associate, Mr. G. A. Pritchard. The chief products of these properties are ilmenite, a titanate of iron having the approximate formula $FeTiO_3$; zircon, a silicate of zirconium, having the formula $ZrSiO_4$; rutile, a natural oxide of titanium, TiO_2, and monazite, a complex phosphate of cerium, thorium, and other elements. These properties were first developed by us commercially in 1916, and since that time their total production of ilmenite and zircon has been many thousands of tons. The 1922 production from these deposits was roughly 5,000 tons. The present production of the mill at Mineral City is approximately the same. The past and present production of zircon, while not so great as that of titanium, is also on a considerable scale. The Buckman and Pritchard properties contain immense quantities of titanium and zirconium minerals.

"There are other immense deposits of ilmenite and zircon available for utilization, including deposits in Canada, in South America, and in many other parts of the world. There is no lack of these raw materials, and they can be made available just as fast as they are required in the industries.

"The chief use of titanium is at present in the manufacture of white pigments, and into this industry many thousands of tons of ilmenite go each year. The old terminology, 'rare earths,' dies hard, but there is nothing rare any more about zircon and titanium minerals, respecting either their occurrence or their utilization in the arts.

"H. H. BUCKMAN,
"President."

New Books

Business Principles Applied to Engineering

Engineering Economics. By J. C. L. Fish. McGraw-Hill Book Co., New York. Price, $3.

How to realize the maximum profit is the basic problem of any engineering undertaking. To play his part adequately, the engineer must do more than merely advise the "business" man. He should be a business man; he should be able to analyze a problem and to reach final conclusions himself.

The most complicated problem can be taken apart and divided into a number of simple problems that can be answered by almost anyone. The difficulty arises in separating the major problem into its component parts and discovering the relations between these parts. This is what we call analysis. No matter what the problem, the principles and methods of analysis are much the same. This excellent book is a guide to the correct analysis of any business problem that involves engineering; and most of them involve engineering as essentially as they do finance.

The book is designed as a textbook, and in some respects it wastes space on elementary discussions. If this is a fault, it is not a serious one. It is well written; it is well arranged; it is apparently carefully proofread. It contains numerous graphical analyses that are simple enough to be understood and yet comprehensive enough to be of value. The chapter on Engineering Reports can be read to advantage by any engineer. The appendix contains valuable information.

The author calls the book "an analysis of the investment problem." We should say that a careful reading would afford an insight into the inner working of an industrial enterprise that is indispensable to the progressive engineer. The book is full of good common sense.

A. B. PARSONS.

A New Petroleum Directory

Petroleum Register, January, 1923, Edition. Published by Oil Trade Journal, Inc., 350 Madison Ave., New York. Price, $10.

All who are interested in the petroleum industry will welcome this latest edition of what has proved to be of value as a directory and statistical record of the industry. Information regarding more than 11,000 companies in this country and abroad is given in its 429 pages. To keep pace with the frequent changes and developments in the petroleum world, the publishers have decided on a semi-annual edition appearing in January and July. At the same time the size of the book has been reduced, although it is said to contain 25 per cent more information than before. In addition to its catalog of companies, it contains a buyers' guide, a list of trade names and one of oil associations, also a bibliography of oil and gas, a statistical section and twenty-three full-page maps.

Four English Yearbooks

Quin's Metal Handbook and Statistics. Compiled by L. H. Quin. The Metal Information Bureau, Ltd., 7 East India Ave., London, E. C. 3, England. Price, 5s.

This annual now appears in the 1923 edition, with data for the preceding year. It is similar to the yearbook published by the American Metal Market in this country, and gives production, import and export, price, and other statistics of grades and brands, for all of the principal metals and some ores.

Mechanical World Year Book, 1923. Mechanical World, 65 King St., Manchester England. Price, 1s. 6d.

Mechanical World Electrical Pocket Book, 1923. Also 1s. 6d. from the same publishers.

These little books contain a great deal of valuable data similar to that found in pretentious handbooks costing a great deal more. That first mentioned also contains a classified buyers' directory, giving the names of the principal English manufacturers of equipment. The index to this directory is published in English, Russian, French, and Spanish.

The South African Mining and Engineering Journal Year Book. Obtainable from the Argus South African Newspapers, Ltd., Byron House, 82-85 Fleet St., London, E. C. 4, England. Price, 12s. 9d.

This pretentious review of the South African mining industry, comprising over 400 9¼x14-in. pages, is intended to celebrate the production by Southern Africa of minerals to the value of £1,000,000,000 in the last fifty years. Every company of any importance is described in considerable detail, and there are many general articles on the various districts, industries, and technical developments. Any one who follows the South African mineral industries will find this a most valuable reference book.

Scientific Books—In the *Engineering and Mining Journal-Press* of June 3, 1922, was published a list of 100 scientific books of interest to the general reader. As many of these were out of print, and have been criticized for other reasons, the Washington Academy of Sciences has now issued a revised list, a copy of which, with brief descriptions, names of publishers, prices, and other relevant information may be obtained for 20c. from the American Library Association, Chicago, Ill. Any one anxious to broaden his scientific knowledge and not sure what books to read will find this new list invaluable. The books have been selected on a basis of readability as well as reliability, and the general reader should not find them unduly dry.

Technical Papers

Southern Magnetite—Bulletin 735-G of the U. S. Geological Survey, Washington, D. C., obtainable on request, is a 60-p. bulletin describing "General Features of the Magnetite Ores of Western North Carolina and Eastern Tennessee." The ores described do not seem to have promising possibilities of economic exploitation under present conditions.

Metallurgical Accidents — Technical Paper 327 of the U. S. Bureau of Mines, Washington, D. C., pp. 31, obtainable on request, summarizes accidents at metallurgical works in the United States during 1921.

Metallurgy of Lead-Vanadate Ores—U. S. Bureau of Mines *Reports of Investigations,* Serial No. 2,433, pp. 19, is entitled "Metallurgical Possibilities of the Descloizite Ores at Goodsprings, Nevada." It may be obtained from the Bureau for the asking. The paper describes laboratory tests and suggests the proper procedure for commercial recovery of the valuable constituents of the ore.

Petroleum—"Structure and Oil and Gas Resources of the Osage Reservation, Oklahoma," is the title of Bulletin 686 of the U. S. Geological Survey, accompanying which is a separate set of thirty-two unbound structure maps. The bulletin includes twenty-five papers on different townships by various authors, with a sixteen-page introduction by David White. The report has been issued to supply a need for geological information regarding the Osage lands. The discussions of the structure are confined to those practical questions which are most important to the oil prospector. Suggestions are made as to points favorable for initial wells to test undrilled areas. The bulletin covers 420 pages.

Oil Shale—Victor C. Alderson reviews oil-shale developments throughout the world during 1922 in the January issue of the Colorado School of Mines *Quarterly,* Supplement B. The subject is treated by states and countries. The bulletin concludes with a bibliography for 1922. Supplement A of the same issue contains a paper entitled "A Chemical Examination of the Organic Matter in Oil Shales" by Ralph H. McKee and Ralph T. Goodwin. Charts and micrographs serve to illustrate it, and a bibliography of the subject is included.

Petrography—In the February issue of *The Mining Magazine* (Salisbury House, London Wall, London, E. C. 2, England; price, 1s.) is a thirteen-page article "The Study and Correlation of Sediments by Petrographic Methods." The author not only discusses the subject from the theoretical standpoint, but points out the economic applications to alluvial mining and oilfield development.

Gases in Metal Mines—Irrespirable gases are not confined to coal mines, and unventilated raises in metal mines may contain high-nitrogen gases that will not support life or combustion. Analyses and an account of conditions under which they are present are given in U. S. Bureau of Mines *Reports of Investigations*, Serial No. 2,427, pp. 4, entitled "Rock Strata Gases in Mines of a Nevada Mining District." It is obtainable free on request to the Bureau.

Petroleum—The proceedings of the First All-Russian Congress of Oil Operators, held in Moscow in January, 1922, are published in four volumes just received. Except for brief extracts in English, the reports are in the Russian language. A fifth volume is a catalog of patents covering oil-well machinery and devices.

Explosives Engineering—We are in receipt of a new magazine called *The Explosives Engineer*, to be published by the Hercules Powder Co., Wilmington, Del. It is the aim of the editors to make this more than a house organ—rather a real magazine of interest to all users of explosives, whose policy is not to be dictated by the private interest of the explosives company that is publishing it. In short, we understand that the editors hope to do for the powder-using fraternity what the editors of the *Compressed Air Magazine*, for instance, published by the Ingersoll-Rand Co., are doing for those interested in that subject. The make-up of the first issue is, for the most part, attractive and the contents are interesting. The subscription price is stated to be $3 a year.

Texas Geology—*Professional Paper* 131-D of the U. S. Geological Survey, Washington, D. C., pp. 30, obtainable on request, is entitled "A Geologic Reconnaissance in the Gulf Coastal Plain of Texas Near the Rio Grande." The paper is largely devoted to the stratigraphy of the region and is illustrated by a colored map of the territory described and numerous plates of eocene mollusca.

Gold Mining—In the March issue of the *Pacific Mining News* of the *Engineering and Mining Journal-Press* (Rialto Building, San Francisco, Calif.) is an article on the present status of the Alaska Juneau mine (pp. 6), and also a three-page article describing a new kind of gold dredge of the drag-scraper type.

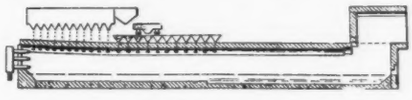
Loading in Quarries—"Rock Loading at Lime-Plant Quarries" is discussed by Oliver Bowles in U. S. Bureau of Mines *Reports of Investigations*, Serial No. 2,446, obtainable from the Bureau on request. This five-page paper is one of a series on particular problems in the lime industry, and discusses chiefly the relative advantages of steam shovel and hand loading.

Amalgamation and Cyaniding—The A.I.M.E., 29 West 39 St., New York City, has published a four-page paper "Relative Efficiency of Amalgamation and Cyaniding," describing tests made on Homestake ores.

Recent Patents

Oxygen-Enriched Air—No. 1,445,973. Feb. 20, 1923. M. H. Roberts, Jersey City, N. J., and C. C. Van Nuys, New York City, assignors to Air Reduction Co., Inc., New York. Air is enriched by liquefying it to a certain degree, and rejecting the unliquefied constituent, which is largely nitrogen. The vaporized product is used as an oxygenated blast for metallurgical furnaces.

Firing Reverberatory Furnaces—No. 1,445,980. Feb. 20, 1923. H. H. Stout, Douglas, Ariz., assignor of 55 per cent to Phelps Dodge Corporation. Pulverized-coal or fuel-oil burners for firing



a copper reverberatory furnace are arranged one above another so that the space between the slag line of a furnace and the arch is a solid mass of flame. The furnace arrangement is shown in the illustration.

Metallurgy of Tin—No. 1,436,961. W. McA. Johnson, Hartford, Conn. A method of subjecting ores to a preliminary reduction so that only one of the elements is reduced, and subsequently heating the mass in the presence of slag-forming material to scorify the unreduced element.

Ball-Mill Discharge—No. 1,436,877. H. W. Hardinge, New York City, assignor to Hardinge Co., Inc., New York City. A new design for the discharge opening for a Hardinge mill.

Ferro-alloy Manufacture—No. 1,437,271. J. M. Skelley and James Merson, Battersea, London, England, assignors to Continuous Reaction Co., Ltd., London. The manufacture of ferrotungsten without the aid of aluminum by the silico-thermic reduction of iron oxide and tungsten oxide in the presence of an oxidizing agent containing nitrogen. Patent No. 1,437,272 covers the manufacture of ferromolybdenum by a similar method, except that molybdenum oxide is used instead of tungsten oxide. Patent No. 1,437,273 covers the manufacture of a chrome alloy, using in this case, chromiferous material.

Cottrell Process—No. 1,446,778. Feb. 27, 1923. G. A. Witte, Philadelphia, assignor to International Precipitation Co., Los Angeles, Calif. The patent covers the distribution in the gases, before precipitation, of a finely divided solid material of a granular nature adapted to act as a weighting, compacting, and granulating medium and thus affording a heavy deposit by Cottrell treatment rather than a light flocculent deposit which would otherwise be obtained.

Flotation—No. 1,447,006. Feb. 27, 1923. L. M. Barker, Hayden, Ariz. A method of diffusing the oil into a flotation pulp through a fine netted material.

Flotation—No. 1,445,989. Feb. 20, 1923. W. O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York City. The colloidal constituents are separated from a mineral pulp by a preliminary flotation treatment, after which the pulp is treated by the regular flotation process.

No. 1,446,314. Feb. 20, 1923. J. F. Myers, Canon City, Colo., assignor to the New Jersey Zinc Co., New York City. The pulp is treated with a hydrogel of copper before being subjected to flotation.

No. 1,446,375. Feb. 20, 1923. W. O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York City. Colloidal material is first removed from an ore pulp in amount sufficient to permit sulphidizing the oxidized minerals present. The pulp is then sulphidized to the extent desired, and subjected to flotation. Patent No. 1,446,376 comprises adding to the pulp a colloid which possesses the property of inhibiting the flotation of one of the minerals of the pulp while permitting the flotation of another of the minerals; the pulp is then subjected to flotation, a differential separation of the minerals being effected.

Treatment of Concentrates — No. 1,446,377. Feb. 20, 1923. W. O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York City. A method of treating a mineral concentrate containing colloids which comprises subjecting the concentrate to a deflocculation or dispersion treatment. The mineral constituents are then separated from the dispersed colloids and water by hindered settling.

China Clay—No. 1,446,949. Feb. 27, 1923. Nils Testrup, Westminster, London, England, assignor to Techno-Chemical Laboratories, Ltd., Westminster, London. A method of dewatering china clay.

Ball-Mill Feeder — No. 1,448,628. March 13, 1923. O. H. Johnson, Denver, Colo., and H. F. Webb, Salt Lake City, Utah, assignors to the Mine & Smelter Supply Co., Denver. A ball-mill feeder composed of reversible parts, including several scoops, a deflecting cone at the center of the feeder, and two similar interchangeable scoop flanges secured at opposite ends of the feeder—all as shown in the accompanying illustration.

Metallurgy of Chromium—No. 1,448,036. March 13, 1923. R. E. Pearson and E. N. Craig, London, England, assignors to Durelco, Ltd., London. The trioxide of a chromium-group metal is reduced by immersing a cathode in an intimate pasty mixture of the powdered oxide and an electrolyte in which it is soluble, and passing a direct current through the mixture.

Cone Classifier—No. 1,447,610. March 6, 1923. Charles Allen, El Paso, Tex. A further refinement in the Allen cone classifier and dewaterer.

SOCIETIES, ADDRESSES, AND REPORTS

Mine Safety Conference Held at Globe, Ariz.

Southwest Section of National Council Conducts Third Meeting in Co-operation with Bureau of Mines

BY LOUIS WARE

The practical application of safety measures and methods of maintaining interest in safety were the main topics discussed at the conference of the Southwest Mining Section, National Safety Council, which was conducted in Globe, Ariz., on March 19 and 20. Delegates from New Mexico, California, Nevada, and Mexico were in attendance, together with representatives from almost every mining company in Arizona. Many interesting papers were presented. This meeting was the third of a series that has been conducted by the National Safety Council in co-operation with the U. S. Bureau of Mines. C. L. Colburn, safety expert, of the Bureau, acted as chairman, and the officers of the Globe-Miami Mine Rescue Association assisted in making the arrangements.

The first session was confined to the discussion of mine fire prevention and fighting, and papers were presented by Charles A. Mitke, of Bisbee, Ariz.; L. H. Duschak, of San Francisco; A. C. Stoddard, of the Inspiration Consolidated Copper Co., and Benjamin F. Tillson, of the New Jersey Zinc Co.

The second session was devoted to the general subject "Responsibility for Safety." A paper prepared by Robert E. Tally, general manager of the United Verde Copper Co., pointed out the responsibilities of the management for the safety of the men and outlined the co-operation necessary for the organization of effective methods. The "Responsibility of the Foremen" was the subject of Joseph L. Johnson, general foreman of the Inspiration mine, who gave practical suggestions for handling men at the time of mine fires. Joseph Harris, shift boss with the Miami Copper Co., and Edward W. Schmidt, of Inspiration, discussed the duties of the mine shift boss in maintaining safe practices and his responsibility to both the management and to his men. W. J. Galbraith, mining attorney and former Attorney General of Arizona, in his paper on "Responsibility of the State and Federal Governments Toward Safety in the Mining Industry" told of the legislative measures employed for the prevention of accidents and the value of co-operation between the legislatures and the operators.

The methods employed for the maintaining of safety interest was discussed in a number of papers presented at the third meeting of the conference, the many delegates giving detailed practices at the various mines and the manner in which the ideas are kept before the employees. D. J. Parker, Chief of Safety Service Division, U. S. Bureau of Mines, told of the assistance given by the Bureau, speaking particularly of the mine rescue cars.

Discussions following the sessions brought out many practices and problems that are met with at the different mines the delegates represented. Thomas Copperwaite told of the results obtained by the paying of a bonus to the shift bosses at the Calumet & Arizona for the lowest accident records, giving detailed figures as to the methods of arriving at the rates to be paid. The importance of keeping men on one particular kind of work and the necessity for schooling them in the dangers of different jobs, if they are changed, was emphasized by C. W. Moon, of Phelps Dodge Corporation.

Following the meeting, two days of mine rescue maneuvers were held which were participated in by trained crews from the mines of the district. About sixty helmet men took part in these maneuvers, and smudge pots, dummies, and various equipment installed in an abandoned section of the Old Dominion mine afforded as nearly realistic conditions as could be had.

At the close of the conference, the Southwest Mining Section adopted a resolution to recommend to the National Council the adoption of standard safety signals and a standard signal for mine fires. Another resolution adopted recognized the value of the conference and recommended that the meetings be held annually in different parts of the section.

Distinction for Geological Achievement

Society of Economic Geologists Establishes Gold Medal

The first medal for the geologic sciences has been established by the Society of Economic Geologists, the foundation being the gift of the first president of the society, Dr. R. A. F. Penrose, Jr. The medal will be given in recognition of unusually original geological work. The recipient of the medal need not be a member of the Society of Economic Geologists, but if he has done any geologic or other work remarkable in the earth sciences, he may be awarded the medal regardless of whether or not he belongs to any society. The first presentation may be made at any time, and under no circumstances will the second or succeeding presentations be made in less than three years. Beyond the limit specified the medal may be presented at any time that any geologist or worker in the earth sciences shall show the necessary merit. The granting of the medal will be decided by the elective officers and council of the Society of Economic Geologists, consisting of the president and vice-president, together with the five members of the council, creating in all a voting body of seven members, of which six shall constitute a deciding vote.

The medal bears on one side the two hemispheres, which is the insignia of the Society, the other side being reserved for the presentation inscription.

Lake Superior Institute's Plans To Be Announced Soon

A. J. Yungbluth, secretary of the Lake Superior Mining Institute, will soon issue his report of the last meeting of the Institute and will also announce the program for the fall meeting which is to be held on the Mesabi Range, in Minnesota, late in August or during the first week in September. Among the places of interest to be visited are the steel plant of the U. S. Steel Corporation in Duluth, and the Babbitt concentrator on the eastern Mesabi.

Utah Chapter of Mining Congress Elects Officers

Officers of the Utah Chapter of the American Mining Congress were recently elected as follows: E. J. Raddatz, governor; V. S. Rood, first vice-governor; W. Mont Ferry, second vice-governor; H. M. Hartman, third vice-governor; A. G. Mackenzie, secretary-treasurer. E. J. Raddatz, L. S. Cates, G. W. Lambourne, D. D. Muir, Imer Pett form the governing board. Directors are: M. R. Evans, W. Mont Ferry, H. M. Hartman, C. E. Loose, J. A. McCaskell, E. L. Newhouse, Jr., and J. B. Whitehill.

Survey Members Dine

The Pick and Hammer Club of the U. S. Geological Survey held its annual dinner March 16 in Washington, D. C., at the Hotel Washington.

Mining Congress Organizes Southern Division

Organization of the Southern Division of the American Mining Congress was perfected at a meeting held March 27 at Nashville, Tenn., under the auspices of William H. Lindsay, of the Napier Iron Works, a director of the Congress and a temporary director of the Southern Division.

J. F. Callbreath, secretary of the Min-

ing Congress, attended the Nashville meeting, subsequently setting out on a tour of the mineral sections of the Southeastern States in the interests of the organization.

The Southern Division was authorized at the Cleveland convention of the American Mining Congress last year, with the purpose of establishing divisional headquarters in that territory and bringing the work of co-ordinating the interests of the mineral districts of the South more intimately than could be accomplished from the national headquarters in Washington. It will be the third geographical division of the Mining Congress.

MEN YOU SHOULD KNOW ABOUT

Noah Timmins, president of the Hollinger Consolidated, is in London.

Oscar H. Hershey has recovered from a recent illness and has resumed his work.

C. M. Weld, of Weld & Liddell, New York, has recently been in the coal fields of West Virginia.

John Uno Sebenius, of Duluth, general mining engineer of the Oliver Iron Mining Co., is in Florida.

H. G. S. Anderson has resigned as assistant general manager of the Chino Copper Co. at Hurley, N. M.

John Carter Anderson, of Tucson, will have charge of construction work at Nacozari for the El Canario Copper Co.

H. W. Davis, of the U. S. Geological Survey, is in Kentucky collecting statistics for the mineral resources reports.

Malcolm Maclaren, of London, has been making a geological examination of the Camp Bird mine, at Ouray, Colo.

T. J. Donoghue, vice-president of the Texas Co., with headquarters in Houston, Tex., was in New York recently on business.

T. I. Crane, of Pittsburgh, and **W. R. Wade,** of New York, connected with the New England Zinc Co. are in southern California.

E. H. Buckner, president and general manager of the Houston Oil Co., returned to Houston recently after a business trip to New York.

T. W. Vaughan, of the U. S. Geological Survey, has accepted an invitation to deliver a lecture at the University of Wisconsin and at the University of Iowa.

W. H. Herron, of the U. S. Geological Survey, is in Urbana, Ill., in conference with the acting state geologist regarding field plans for the forthcoming season.

Justice F. Grugan, president of the Mines and Petroleum Registry, New York, is in Alabama investigating iron and coal properties. He expects to return in a few days.

R. V. Le Sueur, of Sarnia, Ontario has returned from a visit of several months to Colombia, South America, in the interests of the Capital Oil Co. of which he is a director.

S. A. Spellmeyer, formerly with the San Luis Manufacturing Co., at Tayolteta, Durango, Mexico is now connected with the Calaveras Copper Co., at Copperopolis, Calif.

R. P. McLaughlin, petroleum engineer and geologist, has opened an office in the Wright & Callender Building, Los Angeles. He will continue to maintain his San Fancisco office. With him are associated **J. E. Elliott** and **F. C. Merritt.**

Dr. L. D. Ricketts, of Warren, Ariz., has resigned as a member of the board of regents of the University of Arizona, the reason assigned being that a proposed trip to South America would conflict with his duties as a member of the board.

R. B. Walthal, of Austin, Tex., has been appointed chief supervisor of the oil and gas division of the Texas Railroad Commission, to succeed J. W. Hassell, resigned. During the last two years Mr. Walthal has been secretary to Governor Neff.

Mining and metallurgical engineers visiting New York City last week included: **Joseph Pheby,** of San Francisco; **Lucien W. Smith,** of Leadville, Colo.; **Francis C. Frary,** of Oakmont, Pa.; **J. R. Tholneur,** of Cave-in-Rock, Ill.; and **E. O. Daue,** of Philadelphia.

OBITUARY

Stephen Orr, a northern Ontario prospector, died in Toronto on March 19, aged seventy-six years. Mr. Orr was the discoverer of the Orr property recently acquired by the Teck-Hughes. For the last two years he had been resident in Toronto.

Robert Baxter Elder, instructor in metallurgy at the School of Mines, University of Idaho, and assistant metallurgist of the Idaho Bureau of Mines and Geology, died at Denver, Colo., on March 11. Mr. Elder was graduated from the Colorado School of Mines in 1908 and, following an experience with the Coast and Geodetic Survey, he entered the service of the Chiksan Mining Co., in Korea. In 1919 he returned to the United States, and accepted a fellowship in metallurgy at the University of Idaho. Here he speedily demonstrated marked research ability and distinguished himself in the fundamentals of flotation. At the conclusion of his fellowship, he was tendered a teaching and research appointment which he accepted. His paper "Interfacial Tension Measurements and Some Applications to Flotation" published by the Idaho Bureau of Mines and Geology, attracted wide attention, and a later publication, "Notes on the Measurement of Surface Tensions" issued by the *Journal of Physical Chemistry,* showed evidence of an unusual grasp of the physical basis of flotation phenomena. Shortly before his last illness he had been engaged in an investigation of classification as applied to concentration practice in the Coeur d'Alenes.

Samuel D. Nicholson, United States Senator from Colorado, died in Denver on March 24. He was born on Prince Edward Island, Canada, but moved with his parents to Bay City Mich., while still a boy. It was in the public schools of that city that he received most of his education. In 1881, young Nicholson went to Colorado where he worked in the metal mines of Leadville and the coal mines of Trinidad. He became foreman in a short time and a few years found him managing a mine. His ability soon won the recognition of the Guggenheims who placed him in charge of their field operations at Leadville. Soon after, he was made president of

Senator S. D. Nicholson

the Western Exploration Co. He was also a director in the Denver National Bank, the Denver Tramway Co., the American National Bank, of Leadville, and the First National Bank of Monte Vista. In the early nineties, Mr. Nicholson began to show an increased interest in politics, and in 1893 he was elected Mayor of Leadville, serving two terms. Twice thereafter he sought the Republican nomination for Governor of the State. Each time he was defeated in the primaries by small pluralities. During the war he served as State Chairman of the Liberty and Victory loan campaigns. He was also State Chairman of the Roosevelt Memorial campaign and of the Salvation Army drive, and a member of the Colorado United States Fuel Administration. On Nov. 2, 1921 he was elected United States Senator to succeed Charles S. Thomas. In Congress, Senator Nicholson introduced a resolution recommending the creation of a joint Congressional commission to inquire into the causes for the decrease in the production of gold and silver in the United States. He was one of the leaders in the fight for higher duties on graphite during the tariff wars of last spring.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

THE new Copper Queen concentrator at Bisbee, Ariz., has received its first ore from Sacramento Hill. Primary breaker handles 40-ton cars of steam shovel ore at rate of one per minute. The capacity of the plant is 4,000 tons per day.

Dividends from Coeur d'Alene mines in Idaho total nearly $1,000,000 in first quarter.

The United States Zinc Co. is ready to start new zinc plant at Amarillo, Tex.

Calculations show that Joplin-Miami producers profited from lead, not zinc, output during 1922. This is based on average price for year.

Silver mines in South Lorrain district, Ontario, continue to mine bonanza ore.

Wage raises become effective in Ely, Nev., and at El Paso, Tex.

The current report of the Premier Gold Mining Co. shows a definite diminution of the gold content of the ore on the lower levels of the mine.

Copper is shipped as fast as it is smelted in Michigan; none accumulates on the docks.

Old Dominion smelter will be improved if favorable smelter contract is not obtained from the International Smelter at Miami.

Coeur d'Alene Dividends for Quarter Just Under $1,000,000

Idaho Properties Thrive on Lead and Silver Markets—Active Development of Non-Producers

The first quarter of 1923 shows a fine dividend record for mines of the Coeur d'Alene district, and indicate that the disbursements for the year will be double the record of 1922. Hecla leads the list with a dividend of $250,000 for the first quarter. Then follows the Bunker Hill & Sullivan with $245,250; Federal Mining & Smelting Company, $210,000, and Tamarack & Custer, $100,000. The Hercules payment is estimated at $150,000, making the total for the quarter $955,250. In 1922 the total dividends were $2,288,750. It is regarded as possible that the Callahan and Success will be among the dividend payers during the year. Profits of the mines will doubtless suffer through the drop in the price of silver following the completion of the Pittman act purchases, but local operators feel that continued high prices for lead and zinc are assured; this will go far toward compensating the silver loss. High metal prices are stimulating mining development among non-producers.

Rumanian Reform Bill Protects Owners of Mining Concessions

By Cable from Reuters to "Engineering and Mining Journal-Press"

Bucharest, March 20.—One of the articles of the Rumanian Reform Bill which was passed by the Chamber today provides that all underground wealth must become the property of the State. The rights of present owners and concessionaires will be respected.

Clifton (Ariz.) Smelter to Restart on May 1

The opening of the Clifton smelter on May 1 has been announced by J. P. Hodgson, manager of the Phelps Dodge Corporation, Morenci branch. Effective with the reopening of the smelter a 10 per cent wage increase will be made. The initial production of the smelter will be 2,000,000 lb. of copper per month. One hundred and twenty-five men will be employed.

California Gold Mine Is Closed; Safety Rules Too Hard

Because it was found impossible, according to the operators, to comply with the new rules of the Industrial Accident Commission adopted recently, the Sybil, most important gold mine in the French Gulch district, in California has been shut down. The rules have to do with the measures that must be taken to prevent and control fires in mines. They are particularly stringent and are the consequence of the fire in the Argonaut mine last fall.

Stop Work on Mill and Rush Dump Ore to Smelter

The approach of the fulfillment of the Pittman Act silver purchases is stimulating the movement of silver ores. The Ash Peak mine, near Duncan, Greenlee County, Ariz., is endeavoring to ship 20,000 tons of 16-oz. ore, now in dumps, to the El Paso smelter before the price of silver breaks. Four trucks are hauling in double relays, to Sheldon station on the Clifton branch of the E. P. & S. W. R.R. Construction work upon the mill has been stopped. Charles Murphey is in charge.

Beaver County, Utah, Silver-Lead Mines Are Merged

Moscow Mine, Once Producer, Is Nucleus of Group—Legal Difficulties Cured

Work is soon to be resumed at the Moscow mine, for years a steady producer, and the adjoining Beaver Combination and Red Warrior mines in Beaver County, which have been merged under the Moscow Metals Co. Exploration work continued in the Moscow, which at the time of its shutdown was producing eighteen to twenty cars of lead-silver ore monthly, had reached a point so near its end line, that a consolidation with adjoining properties appeared the most advantageous and economical arrangement for development. Legal entanglements in the way of exploitation of the properties have now been set aside, and the new company, capitalized at $250,000, divided into 2,500,000 shares, has filed articles of incorporation with the secretary of state. Officers of the company are: Fred J. Leonard, president; Garrett Wilkin, general manager; J. A. Foley, vice-president; M. B. Johnson, secretary-treasurer. The company has a full equipment — including an electrically operated compressor and hoist.

French Metallurgical Industry Hampered by Coke Shortage

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, March 24.—A message from Paris states that the French metallurgical industry is almost stationary. Sufficient supplies of Belgian coke are arriving to prevent further dampings down.

Propose to Curb Personal "Peddling" of Stock

A bill has been introduced in the Canadian Senate making it an indictable offence for any one to solicit the purchase of stock unless authorized in writing by Dominion or provincial authorities. The measure does not apply to solicitation by advertisements or printed circulars. It has received a second reading.

Pittman Act Silver

Purchases of silver by the Bureau of the Mint during the week ended March 24 amounted to 2,498,000 oz. This brings the total purchases under the Pittman Act to 167,557,068 oz., and leaves about 40,000,000 to be purchased.

U. S. Zinc Co. Ready to Start New Zinc Smelter in Texas

The opening of the first block of the new zinc plant, being erected at Amarillo, Tex., is set by F. P. Lennon, general superintendent of the U. S. Zinc Co., for April 1. The main pipe line from the Amarillo Oil company's big gasser is connected and was tested on March 20. This plant will handle ores from New Mexico, Colorado, and old Mexico. The plant is located between the Rock Island and the Fort Worth and Denver railroads. Commissaries, lunch rooms, hotels and groceries have been built by the company and the location is known locally as North Bend. Charles E. Gregg, formerly of Henryetta, Okla., will be in charge as superintendent. It is expected that other smelting plants will be attracted to this field by the immense flow of natural gas that has been developed here recently.

Will Ford Buy a Michigan Copper Mine?

Rumor persists that Henry Ford will buy a copper mine. To date, however, there is no substantial basis for such belief. The rumor had its origin in a visit by Mr. Ford earlier in the year to his new sawmill holdings at L'Anse, in the upper peninsula of Michigan, and in his announced intention at that time to pay a visit to Calumet in the copper district. He failed to visit Calumet, however, a change in plans sending him back to Detroit. Recently, the rumor was given a new lease of life when James MacNaughton, general manager of Calumet & Hecla and subsidiary mines, went to L'Anse to confer with a party of Ford officials from Detroit. It was announced by Mr. MacNaughton, however, that neither the mineral nor the timber holdings of the Calumet & Hecla properties were involved in the matter, although the real purpose of the conference was not divulged. Mr. Ford has acquired iron and coal mines, sawmills, railroads, water-power, glass and rubber plants. He is a large consumer of copper. So the question is naturally asked, "Will he buy a copper mine?"

Joplin-Miami Operators Profited From Lead, Not From Zinc

Compilation of Average Figures for 1922 Shows Concentrate to Cost $37.47 Per Ton—Cost Per Ton of Rock Only $1.7373

THE COST of mining and milling in the Joplin-Miami district averages $1.7373 per ton of ore hoisted, according to figures computed by Baird, Kurtz & Dobson, certified accountants. However, depletion, royalty and depreciation are not included in this estimate.

The computations were made by the firm from twenty representative mines in the field in 1922. The complete tabulation of figures, which should be interesting to mining men of other fields, is as follows:

Figures show that for the entire year zinc concentrate was sold at an average loss of 86.47c. per ton, and lead at a profit of $32.8066. In other words, any money which was made in the district last year was made out of lead and not out of zinc. The average profit for both lead and zinc is $6.4733, or a net average profit of 14.99 per cent. Zinc has for many months been selling at a much higher figure than the 1922 average so that the zinc concentrate now brings a profit.

Average Operating Cost for Twenty Mines—1922

	Average Cost per Ton of Ore Mined and Milled	Percentage of Each Expense to Total
Labor	$0.8446	48.61
Explosives	0.1723	9.92
Supplies and repairs	0.3099	17.84
Power and power fuel	0.2097	12.07
Liability insurance	0.0387	2.22
Fire and tornado insurance	0.0214	1.24
Salaries	0.0608	3.50
Miscellaneous	0.0799	4.60
Total mining and milling	$1.7373	100.00

	Average Cost per Ton Concentrate Produced	Percentage of Each Expense to Total
Labor	$12.3327	32.91
Explosives	2.5159	6.71
Supplies and repairs	4.5251	12.07
Power and power fuel	3.0630	8.17
Liability insurance	.5651	1.51
Fire and tornado insurance	.3133	.84
Salaries	.8884	2.37
Miscellaneous	1.1662	3.12
Total mining and milling	$25.3697	67.70
Royalty	6.0408	18.52
Depreciation	2.4089	6.43
Depletion	2.7541	7.35
Total average cost per ton of concentrates	$37.4735	100.00

The average cost per ton of concentrate including lead and zinc is $37.4735. This includes royalty, depreciation and depletion.

The average recovery for the year 1922 was 108 lb. of zinc concentrate and 28.4 lb. of lead concentrate per ton of ore mined.

Average Income and Expenses Per Ton of Concentrate Sold—1922

	Zinc	Lead	Lead and Zinc	Per Cent of Selling Price
Gross selling price per ton	$34.2165	$75.3989	$43.1914	100.00
Royalty	5.3039	12.8150	6.9408	16.07
Net selling price per ton	$28.9126	$62.5839	$36.2506	83.93
Operating cost pr ton of concentrates sold	24.6143	24.6143	24.6143	56.99
Average net operating profit per ton of concentrates sold	$4.2983	$37.9696	$11.6363	26.94
Depreciation	2.4089	2.4089	2.4089	5.58
Depletion	2.7541	2.7541	2.7541	6.37
Average net profit per ton of concentrates sold	.....	$32.8066	$6.4733	14.99
Average net loss per ton of concentrates sold	$0.8647			

Gold Canyon Dredging Co. Will Discontinue

The Gold Canyon Dredging Co., which constructed and placed in operation a modern 9 cu.ft. gold dredge in September, 1920, between Silver City and Dayton, Nev., will discontinue operations on April 1. The dredge will be dismantled and used upon a new area as soon as a suitable gold dredging property can be acquired. The operations in Gold Canyon have proved disappointing due principally to the difficulties in working the ground. Large boulders in unusual number interfered with the operations, reducing the capacity of the dredge and also increasing the cost for repairs and maintenance to such an extent as to wipe out the profit which might have been expected. The project was one of a number undertaken by the Metals Exploration Co. of which Bulkeley Wells is the dominant figure.

Tributers Make Money and Companies Develop in Kalgoorlie, Australia

South Kalgurli Finds Rich Ore—Lake View Mill Runs Intermittently—Kalgurli Looks Better

BY PETER G. TAIT

The present position of the Kalgoorlie mines is set forth in a recent departmental report. The Perseverance mine is still in the hands of tributers, sixty to seventy parties, ranging from two to ten men in each, being engaged, and these are distributed throughout the mine, from the surface down to the 1,900 level. The tributers, in the majority of the blocks, are underhand stoping, and not much development work is being carried on. They are making more than wages.

At the Horseshoe mine development work has not been active during the last year, but a payable orebody is now being driven on at the bottom level. The Ivanhoe has done a good deal of development from its 2,570 level by winzing.

On the South Kalgurli development has been from the main shaft at the 1,500, 1,600, and 1,700 levels, opening up large bodies of high-grade ore, chiefly south of the shaft, and the operators have rich ore in the face close to the Associated mine boundry which, it is thought, should pass into their ground. The Associated mine has also developed steadily through the year, but unfortunately, though obtaining payable "values" in several places from the 1,600 level upward, they have not proved of great extent.

At the Great Boulder development work has taken place from the surface north of the mail shaft, but the orebodies are small, and values low from Lane's shaft end.

The stamp mill on the Lake View mine was closed down about the middle of the year, but development work has been carried on, chiefly by driving on the two lodes at the 2,300 level, which it is understood are opening up satisfactorily. In the meantime the mill is being run at intervals on tributers' ore and some of the parties at work are obtaining good returns. On the Chaffers mine a new dry mill is being erected.

The Kalgurli mine has been reopened, and "tributes" have been let from the surface down to the 1,700 level and a few good parcels taken out. Two parties are mining good pay ore from the 100 level upward. Judging from the distance between these two parties, they both being on the same lode, a large tonnage will be taken out this year. A party below the 1,700 level is also developing a fine looking lode. It is thought that during the year this mine will turn out well. The mill has been put in order, and is kept going on tributer's ore drawn from the Kalgurli, Croya North Blocks, Brown Hill, Associated Northern, North Kalgurli, Paringa, and parcels sent by rail from outlying districts, and it appears to give general satisfaction.

Kellock and party on the North Kalgurli are following a payable shoot of ore near the Hainault boundry, and two other parties are on pay-ore near the Paringa boundary, but no machinery is in motion on the mine.

The Brown Hill and Associated Northern are in the hands of tributers, and some rich returns from small parcels, chiefly from pillars and rich telluride veins in the footwall of the rich ore pipe, have been obtained.

The Eclipse mine (Oroya-Links) is being unwatered to further explore the bottom level, which is 1,000 ft. in depth.

On the Central lease, south of the Hidden Secret, Mayman and party have erected a Huntington mill, and are milling ore which is just payable, from the 150 to the 100 level, in an orebody which is wide and easily mined, and Raven and party are erecting machinery preparatory to unwatering the Hannans North mines. They should make a start soon.

Old Dominion, Failing to Make Smelter Contract, Will Improve Own Plant

Charles S. Smith, after his annual visit to the properties at Globe, Ariz., of the Arizona Commercial and Old Dominion companies, of which he is president, announced that the condition of the two mines is excellent and that he is enthusiastic regarding their future. He stated that a point had been reached where it was realized that improvements and enlargements of the Old Dominion plant are necessary. The smelter, which is equipped with blast furnaces and converters only, has been proven to be inadequate and reverbatory furnaces are necessary if efficient reduction of the mine output is to be effected, he stated. The installation of this added equipment will be contingent upon the possibility of Old Dominion securing a satisfactory contract with the International Smelting Co. for the treatment of its ores.

Fire Destroys Metallurgical Building of Michigan College of Mines

The Michigan College of Mines, Houghton, sustained a severe loss when its metallurgy building was destroyed by fire. Building and equipment cost approximately $300,000. The loss comes on top of the refusal of the Michigan Legislature, on grounds of economy, to grant any appropriations for buildings. The work of the department will be carried on in the chemistry building, with improvised furnaces, until such a time as a new structure can be built. Many of the students and members of the faculty lost valuable effects in the fire. Prof. A. T. Sweet, for example, lost notes he had been preparing for twelve years for a new text book on metallurgy. The building was of brick and stone and one of the most substantial on the campus. Included in the structure was the Houghton office of the U. S. Bureau of Mines.

Phelps Dodge Corporation Advises Shippers Regarding Pittman Act

After April 15 Settlements for Custom Silver Ore May Be Made at World Price—Adjustment Later if Necessary

The following circular letter sent to custom ore shippers by the Phelps Dodge Corporation concisely explains the policy of the Corporation and of other smelting companies regarding the payment for silver pending the completion of Pittman Act purchases:

"Owing to increased production of many copper and lead mines during the past few weeks, the production of silver in the United States has increased materially and a further increase from the same cause may be reasonably anticipated. It now seems probable that purchases of silver by the United States Government authorized under the Pittman Act may be completed some time in September of this year.

"When the first purchases of silver were made by the government under the Pittman Act on May 17, 1920, the Treasury Department ruled that four months was a 'fair average time in process' from date of purchase of ore at the smelter to date of delivery of refined silver to the mint.

"Under this ruling, we were enabled to commence purchases at the government price effective with receipts at our works on Jan. 17, 1920, and it must now be clearly understood that we will have to discontinue payments at that price four months prior to completion of purchase of the total amount authorized by the act, or some time in May.

"Until April 15, we will continue payments at the Pittman Act price, when supported by the proper affidavits, and this is to advise you that when at any time thereafter it may seem necessary to us, settlements will be made under the following plan, without further notice: Provisional settlement for silver will be made at current foreign quotations as published in the New York *Engineering and Mining Journal-Press*, and each shipper, in the protection of his own interest will be requested to furnish us the usual affidavit, with the understanding that if the silver is sold by us under the Pittman Act, adjustment will be made for the difference. If we do not sell the silver at the Pittman Act price, the provisional settlement shall stand as final, and the shipper may demand the return of his affidavit.

"While we will, of course, make every effort to protect your interest in the matter of payment, unless we advise you otherwise in the meantime, the above plan will be followed at any time after April 15 without notice."

Burma Mines Increases Mine Output

During February the Burma Corporation from its Bawdwin mines produced 19.297 tons of ore. A total of 19,270 tons of ore was milled. Refinery products were 3,554 tons of refined lead, and 383,615 oz. refined silver. The mine output is higher than usual and reflects improvement in the labor situation.

Boundary Red Mountain Mine Steady Producer of Gold

Amalgamating Stamp Mill Handles $14 Heads—Only Operating Gold Mine in State of Washington

The most important producing gold mine in western Washington is the Boundary Red Mountain property, situated in Whatcom County two miles south of the international boundary. Active work was resumed last October and production has continued steadily since then. The property is equipped with a battery of ten 1,150-lb. stamps and an 8x4-ft. tube mill, with plate amalgamation of both the battery discharge and the reground product of the tube mill. A drag classifier removes the fine material from the tube-mill feed. The mill will handle 50 tons of ore per day. Power is generated on Silica Creek at a point 1½ miles from the mill. A Hendy-Francis turbine operating under a 30-ft. head drives the generator. Three 25-hp. motors drive three small compressors. Auxiliary power for the mill is supplied by an impact water wheel. A 1,600-ft. rope tramway carries the ore from the portal of the main adit down the hill to the mill.

On account of the rugged typography of the country, the orebody has been developed by three adits, known, respectively, as 100, 200, and 500. The vein is from 2 to 3 ft. thick and an oreshoot on the 500 level has been developed for 520 ft. The ore is said to average over 26 in. in thickness and to assay 1.13 oz. gold per ton. As mined at present the mill heads average about $14 per ton. The silver is negligible.

The property was first opened in 1897, but little work was done until George Wingfield took it over in 1915. He built

Corduroy road near Boundary Red Mountain mine

the power plant and completed the mill. After producing in eight months more than $120,000 in bullion, operations were discontinued in 1917 on account of the war conditions.

The current operations are now directed by Joseph Pheby, who is president of the company; Mr. Wingfield, however, still retains control. R. J. Bonnemort is superintendent in resident charge of the mine. The property is reached from Chilliwack, a station on the Canadian National Ry. The accompanying photographs show the character of the surrounding country and part of the camp.

Camp at Boundary Red Mountain gold mine in Washington

News from Washington

By PAUL WOOTON
Special Correspondent

Machinery Moving in Gold-Silver Inquiry

Senator Oddie Probable New Chairman—Sundry Agencies Co-operate—Senator Sterling's Appointment Likely

A LARGE AMOUNT of data on gold and silver will be laid before the Senate committtee of inquiry at the time of its initial meeting, which probably will be April 18. The serious illness and death of Senator Nicholson has interfered with the plan to organize the collection of data but knowing the general requirements of the committee, the Bureau of Mines, the Geological Survey, the American Gold and Silver Institute and the American Mining Congress have gone ahead with the preparation of information which it is known that the committee must have.

C. F. Kelly, F. Y. Robertson, J. H. Brownell, Bulkeley Wells, and J. F. Callbreath, Jr., who constitute the Mining Congress's committee, met at the Bankers Club in New York on March 23. It was the concensus of opinion among the members of the committee that an opportunity is presented by the action of Congress in authorizing this inquiry to bring out information which will be very helpful not only to the producers of gold and silver but to the nation as a whole.

The Gold and Silver Institute is compiling information bearing on the use of silver in the monetary systems of the various countries and is gathering other specific data from producers.

The Bureau of Mines expects to make important use of Charles Janin, one of its consulting engineers in connection with the contribution it will make to the Gold and Silver Inquiry. Mr. Janin has wide knowledge of the difficulties which are facing gold and silver producers and also has made a life-long study of the economics surrounding the uses of these metals.

With the death of Senator Nicholson, the chairmanship of the committee probably will be bestowed upon Senator Oddie, of Nevada. The Nevada Senator was slated to be vice-chairman of the Inquiry and it is logical to conclude that he will succeed to the place that was to have been held by the late Senator from Colorado. The vacancy created on the committee by the death of Senator Nicholson probably will be filled by the appointment of Senator Sterling, of South Dakota. Vice President Coolidge is expected to announce the appointment early in April.

War Minerals Relief Awards

Subject to the approval of the Secretary of the Interior, the War Minerals Relief Commissioner has recommended awards as follows: George S. Ford, Auburn, Calif., $281; Andrew Fogarty, Dutch Flat, Calif., $706; F. J. Abbott, Los Angeles, $6,732; H. F. Sowers, Atlantic City, N. J., $4,461.

Disallowances were recommended in the following claims: Niven, Patterson, and Hazeltine, Canyon City, Ore., net loss not established; J. A. Ferbache, San Francisco, commercial importance not established; Tedoc company, San Francisco, stimulation not established.

How Cheaply Can Chilean Nitrate Be Produced?

Department of Commerce Will Find Out —Export Duty on Chilean Copper Suggested as Possible

The Department of Commerce plans to survey the nitrate situation. It is anticipated that information will be sought as to the exact cost of nitrate production in Chile. Since it is fairly well established that no other natural deposits of nitrate of soda can be developed so as to compete with the Chilean product, the only hope of developing other sources of supply is the encouragement of fixation of atmospheric nitrogen. Before private industry can be induced to undertake nitrogen fixation, it must have exact information as to how low the price of the Chilean nitrate might go if forced to the lowest possible price by competition.

At present a substantial factor entering into the delivered cost of nitrate of soda is the export duty which is exacted by the Chilean Government. It is recognized that that duty could be lowered or even removed altogether if necessary to the continuance of the Chilean industry. Incidentally such a suggestion gives rise to the thought that the Chilean Government, if forced to abandon the revenue it is securing from nitrate of soda, might turn to copper exports to recoup itself. Such a plan would affect American mining interests adversely.

Duty Collectible on Zinc in Lead Ore

Immaterial Whether Zinc is Recovered or Not, According to Ruling of Treasury Department

The Treasury Department has handed down a ruling that duty must be paid on the zinc content of lead ores imported under bond for smelting if the lead produced is sold in the United States, regardless of whether or not the zinc is recovered. The effect is expected to be a further reduction in the price of foreign lead ore containing low percentage zinc for export to this country. If the lead produced from such ores at the domestic smelters is exported, the ruling will have no affect, as neither the lead nor the zinc in such cases is dutiable.

Under the former tariff, the duty on zinc was on an ad valorem basis and a ruling of this character was not necessary because if the zinc was not recovered it possessed no value and there was nothing to tax.

In the tariff act of 1922, however, zinc was placed on a specific basis, ore containing less than 10 per cent of zinc being free; ore containing 10 to 20 per cent zinc being assessed a duty of ½c. per pound on the zinc content; ore containing 20 to 25 per cent zinc being taxed 1c. per pound on the zinc content, and ore containing more than 25 per cent zinc being assessed 1½c. per pound on the zinc content. The duty on lead-bearing ores is 1½c. per pound on the lead content.

No "Dumping" of Ferrosilicon, Says Treasury Department

Acting under the anti-dumping law of 1921, the Treasury Department has issued an order affecting ferrosilicon from Canada. Under this order, collectors of customs are instructed to investigate each entry of ferrosilicon from the Dominion, and if it can be established that the price at which it was sold for delivery in the United States is less than the price of delivery to purchasers in Canada, a sum shall be added to the duty sufficient to equalize the two prices.

Under the 1922 tariff, the duty on ferrosilicon containing 8 per cent or more of silicon and less than 60 per cent is 2c. per pound on the silicon content; containing 60 to 80 per cent silicon, 3c. per pound; containing 80 to 90 per cent silicon, 4c. per pound; containing 90 or more per cent silicon, 8c. per pound on the silicon content.

Arsenic Production Exceeds Manufacturing Capacity

Arsenic production has responded to higher prices more rapidly than manufacturers of calcium arsenate had anticipated, with the result that manufacturing capacity appears to be slightly less that the present rate of raw-material production. It is that situation, more than any decline in demand, which has resulted in the recent slight price recession.

While active steps are being taken to expand manufacturing capacity, none of the manufacturers apparently is willing to undertake large-scale additions to plants. This hesitation is caused by the uncertainty as to the requirements of the country. During a period of shortage, it is recognized that the demand apparently is larger than actually is the case due to inquiries from a single source going to various manufacturers and dealers.

News by Mining Districts

By Special Correspondents in the Field

London Letter

New Maneuver in Burma Mines Finance —R. Tilden Smith Has Smelting Scheme

BY W. A. DOMAN

London, March 16—Some time during last year I wrote concerning the efforts that were being made by the Northern Corporation Co. to raise additional capital. The annual report covering the period to Oct. 31 last has now been issued, and while it contains certain interesting points it cannot be described as altogether a cheery document. To some extent the present condition of the company is attributable to adverse financial conditions, in consequence of which the directors have been unable to sell or lease other parts of the company's properties, but with returning confidence and improvement in trade, they anticipate favorable developments. The property was originally exploited for coal and iron, but copper and zinc deposits of some importance have been found.

I have already referred to the arrangement by which the Sub Nigel Co. (South Eastern Rand) was extending certain of its workings into the Nigel company's property in order to test it at depth. For a time distinctly encouraging values were encountered and hopes that the reef would prove capable of being profitably worked were raised. Now a shock has come in the shape of a cablegram from the mine stating that further driving has proved that values are unpayable. Something over 200 ft. of payable ore have been driven upon, with an average of 11.3 dwt. over 42 in. In itself this would be workable, but as there is so little of it, operations have again ceased and it is questionable whether the directors will consider it wise to spend further money on the property, which has lain dormant for about five years.

Several months ago the Burma Corporation removed its offices from London to Rangoon, partly that the management should be nearer the property, and partly to avoid taxation. Since that time, although the company has done well and the value of the property has improved, interests in the shares on the London market has been much less keen. It is now announced that a deal has been arranged by which the Imperial and Foreign Corporation, Ltd., has acquired a large block of Burma Corporation shares. A holding company is being formed, the capital of which will be, I understand, something in the neighborhood of £1,000,000, of which about £400,000 will be in 7 per cent seven year notes, redeemable at 103½ per cent and the balance in ordinary £1 shares to be issued at par. The number of Burma Corporation shares involved is something like 4,000,000, and the principal contributor to the new company will be R. Tilden Smith, one of the earliest financiers to be interested in the great Burma mine. The idea—Mr. Smith informs me—is to have a kind of holding syndicate similar to the old Bawdwin Syndicate which proved so successful. In connection with this scheme, Baldwins of South Wales will take over the Swansea Vale and Avonmouth Smelting Works erected under the control of R. Tilden Smith and forming the largest smelting works of their kind in this country, if not in the world. The capacity of the works at present is 32,000 tons of metal annually; it is being increased to 40,000 tons and the object is to attain 70,000 tons per annum. Although the works have been idle for some time, a contract has been entered into for the purchase of 150,000 tons of Broken Hill concentrate yearly.

Melbourne Letter

Tasmanian Tin Mine Reopens—New Gold Looks Good

BY PETER G. TAIT

Melbourne, Feb. 5—The recovery in the price of tin has encouraged the Federation Tin Co., which holds a large deposit at Heemskirk, on the west coast of Tasmania, to reopen the mine, which is connected with Zeehan by tramway. Some time ago the company purchased a sixty-stamp battery from the old Tasmanian Gold mine at Beaconsfield, but this has not been transported to the mine, owing to the necessity for raising further capital. A further £50,000 will be raised by the issue of reserve and fully paid shares in the hands of the company. Official estimates state that 500,000 tons of 1 per cent ore is available and that most of the mining would be in open cuts.

Transville is the name given to a new gold find at Mount Juglah, about five miles north from the 37-mile peg (from Kalgoorlie) on the Kalgoorlie-Port Augusta transcontinental railway. It is in close proximity to Block 41 of the Hampton Plains Co. W. F. Grenard, Inspector of Mines at Kalgoorlie, states that the find was discovered in November last year. A number of leases have been pegged and options over leases have been acquired by various companies.

Johannesburg Letter

Knight Central Shuts Down—Bullion Stolen From Railway Train

BY JOHN WATSON

Johannesburg, Feb. 20—At the last meeting of our Chemical and Metallurgical Society, held on Feb. 17, papers were read on: "Recovery of Gold by Blanket Concentration in Substitution of Plate Amalgamation," by F. Wartenweiler; "Notes on Cupellation Losses," by H. R. S. Wilkes, and "Notes on the Contamination of Coke Samples When Prepared in a Disk Grinder," by J. Henderson. There was a fairly good attendance, thirteen new members being elected.

The Consolidated Mines Selection directors recommended on Feb. 15 that a dividend of 12½ per cent (1s. 3d. per share), less tax, be paid to shareholders registered on Feb. 21.

A committee of engineers has recently reported on the closing down of the Knight Central Gold Mine, Ltd. As the ore reserves near the existing shafts are almost depleted, and as large sums of money would be required to explore the deeper ground, the present owners have decided to close down. The report was signed by H. E. Hutton, chairman, F. H. P. Cresswell and J. Whitehouse.

A consignment of nineteen bars of gold was being railed from Van Ryn Halt to Germiston, *en route* to the new refinery on Feb. 15. When the train reached Germiston, four bars were missing. One of the missing bars was found next morning by a railway gauger beside the rail-track near the Avenue Halt at Benoni. The railway police were reinforced by detectives from the Criminal Investigation Department who found marks on the permanent way, indicating the fall of heavy packages. On the north side of the line, on the veld, were found the tracks of a motor car. The value of the three missing bars is said to be not less than £10,000. The refinery will, in future, probably run its own motor trolleys, from the mines to the refinery. Two men have been arrested, appeared at Benoni Magistrates Court, yesterday, and were remanded.

Montreal Letter

Premier's Bonanza Deposits Do Not "Go Down," Admits Recent Report

BY ALEXANDER GRAY

Montreal, March 24.—Accumulating interest in the Portland Canal mining district of British Columbia makes more than welcome the report of the Premier Gold Mining Co. Until recently there were few shareholders to address. H. A. Guess, managnig director, no doubt had a broad purpose to subserve when he reviewed the 1922 operations of British Columbia's largest precious metal producer and frankly stated the mining position and outlook. So much has been said and written of the Premier and its proportions, and the decision of important mining groups to participate in Portland Canal developments is assuming such prominence that the report affords a clearer insight into the actual situation. Evidently, in view of the longer list of shareholders, it has been decided to make Premier affairs public, rather than have misconceptions regarding what has transpired and is in perspective. The following summarizes mining operations for 1922:

Diamond drilling, ft	12,279
Development drifts and raises, ft	6,502
Ore mined, dry tons	102,334
Ore milled, dry tons	32,344
Ore shipped (Tacoma) tons	41,775
Ore shipped (Granby) tons	28,215
Table concentrate shipped (Tacoma) tons	2,511
Flotation concentrate shipped (Granby) tons	1,614
Bullion shipped (Selby), tons	13
Gold produced, oz	127,827
Silver, produced, oz	4,474,367
Ore broken, 1922, tons	163,094
Broken reserve, Dec. 31, 1922, tons	73,000

To more fully comprehend what has been accomplished by the Premier company, and what are the prospects, it is necessary to compare the results of the past three years and then to study the comment by way of explanation of the mining position. Here is the comparative production:

	1922	1921	1920
Ore mined, tons	102,334	18,750	799
Gold, oz	127,827	40,104	2,283
Silver, oz	4,474,367	1,177,978	77,180

All told, the company in those years produced 5,669,525 oz. of silver and 170,210 oz. of gold, with a liquidation value of approximately $7,825,000. The per ton gold content in the respective years was 1.249 oz. in 1922; 2.13 oz, in 1921, and 2.857 oz. in 1920. The silver content per ton mined works out at 43.72 oz. for 1922; 59.62 oz. in 1921, and 96.59 in 1920.

The varied grade by years is attributable to increased operations and to the falling off in values as depth is attained. Regarding what remains at and above No. 3 level of the present working area, the report says:

"A conservative estimate of the general average of the 73,000 tons broken in stopes as at Dec. 31, 1922, is: 0.72 oz. gold and 32.0 oz. silver per ton. With gold figured at $20 per ounce and with silver at 65c., this represents a gross value of $35.20 per ton.

"A conservative estimate of the assured and probable unbroken ore to the present level of the present mine, is 300,000 tons averaging 0.71 oz. gold and 27.0 oz. silver per ton. With gold figured at $20 per ounce and silver at 65c., this represents a gross value of $31.75 per ton.

"The orebodies of the Premier within the area of the present workings have maintained their widths to the present bottom level, and in fact have widened somewhat, the average width on the bottom level being around 15 ft. and with a length, as far as opened up, of approximately 500 ft. The average value of the ore has, however, dropped to a milling grade on the bottom level, the value there being approximately 0.32 oz. gold, 5 oz. silver, and although no development other than by diamond drill has been done below that level, six diamond-drill holes, cutting the orebody at various points to a depth of about 100 ft. below the bottom level, have shown a continuance of approximately the same average grade."

Disappointing as this may seem to be, in a mine that had an assured production of approximately $17,300,000, taking these estimates, the report makes this hopeful reservation:

"The foregoing tonnage estimates do not represent the total probable tonnage from the Premier property, but refer to the total probable tonnage within the limits of the present mine workings. There is some 600 ft. of unexplored ground to the eastward of the present mine workings and along the same ore zone. Also there are possibilities along the southwestward of the same zone, beyond the present mine workings, as well as the possibilities of the vein, with the northwesterly strike and of the various surface showings elsewhere upon the Premier property. Some of which, such as upon the Pictou and Cascade Falls No. 8 claims, have been previously mentioned.

"It is desired, however. to make clear to all shareholders that the very high grade ore—due doubtless largely to secondary enrichment—within the limits of the present mine workings, does not, judging from results of development work to date, go down much, if any, below the point at which the third level is now started, about midway between the second and the bottom or fourth level. this No. 3 level being approximately 600 ft. vertically below the surface.

"Should the southwestern trend of the Premier orebodies beyond the present mine working be found by further development and exploration to carry commercial orebodies, it is possible that these bodies may show high-grade ore at points below the present bottom level, due to the surface contour, the ground sloping toward the southwest, and upon the southwestern trend some 2 000 ft. within the limits of the Premier's property remains as yet unexplored."

ONTARIO

Dome Output Greatly Increased

The fiscal year of the Dome Mines in Porcupine ends March 31, and while official figures have not been given, it is understood that the company will show a substantial increase in practically all departments. Production is expected to be $4,600,000, as against $2,800,000 the previous year, while the profits are estimated at $5.50 a share, as against $2.50 a share of the year before. Broken ore reserves are about 400,000 tons, an increase of 125,000 tons. Cash surplus over all liabilities should be about $3,500,000.

South Lorrain "High-Grade" Unabated

Really extraordinary results are being reported from the Keeley and Haileybury Frontier Mines in South Lorrain, and the sum of $100,000 cash was recently paid for a single undeveloped claim adjoining the Haileybury Frontier, which is owned by the Mining Corporation of Cobalt. It is understood that the Keeley will ship in March about 100 tons of high-grade, averaging around 4,000 oz. per ton. It is not anticipated that production at this rate will be maintained, but the property is now one of the most important silver mines on the continent. The Mining Corporation, operating the adjoining property to the Keeley, is understood to have taken out 1,000,000 oz. from drifts alone. The first real stope has just been opened up, and shows a shoot of ore 90 ft. long, and from 5 to 30 in. in width, running from 3,000 to 8,000 oz. per ton. It is also stated that where the vein is widest the ore is richest.

CALIFORNIA

Mother Lode Activities

After some five months' work the Argonaut shaft has been repaired and the Argonaut mine will be unwatered. Unwatering operations have been started.

The Fremont mill near Amador City has been started.

At the Plymouth sinking of the winze was resumed on March 1. On the 3,850-ft. level, a shoot of ore 115 ft. in length and over eight feet in thickness has been developed. The assay value exceeds $12 per ton. The south drift on the same level at a point 314 ft. north of the main shaft shows an ore face seven feet in width, sampling over $18 per ton.

TEXAS

A. S. & R. Smelter at El Paso Increases Wages

A general increase in wages of 10 per cent has been announced by Kuno Doerr, general manager of the El Paso smelter. This was made effective March 18. Business with the smelters is steadily increasing. The operating force has been increased from 350, a year ago, to 800 at the present time. The Cottrell smoke precipitation unit has been completed at an expense of $50,000 and is working satisfactorily.

IDAHO

Cedar Creek Develops Below No. 3 Tunnel Level

From present indications that section of the Coeur d'Alene district known as the North Side will have a producing lead-silver mine before the end of 1923. This refers to the property owned by the Cedar Creek Mining & Development Co., of Wallace, Idaho. The company has a proved ore shoot over 300 ft. long on No. 3 tunnel level and extending to No. 2 tunnel, 250 ft. above. A shaft is now being sunk from No. 3, on the ore, and will be sunk at least 200 ft., following which the vein will be explored by drifts and crosscuts. If the ore showing proves satisfactory the company will proceed at once with the construction of a mill with the view to placing the property on a productive basis.

UTAH

Tintic Standard Will Pay $117,470 on March 31

The recently declared dividend by the Tintic Standard Mining Co. of Eureka of $117,470, at the rate of 10c. a share, payable March 31, is the twenty-first by the company and will bring the total thus far to $1,949,477. The articles of incorporation of the company were amended at a recent stockholders' meeting so as to permit the company to purchase its own stock. So far, it is stated, no stock has been so purchased, but it is expected that the matter will soon be discussed at a directors' meeting. The company now has 1,174,700 shares of stock outstanding.

New Hoist at Gemini

The Chief Consolidated has a force of men at work dismantling the large electric Nordberg hoist at the No. 1 Iron Blossom workings, which it has purchased for use at the Gemini mine, one of the newer acquisitions at which production is rapidly increasing.

WASHINGTON

Gladstone Finds New "Chimney"

The Gladstone mine near Northport, has added new reserves to the mine by penetrating the No. 5 chimney. The ore deposits of the Gladstone property exist in pipes or chimneys which appear at intervals on the surface. The deposits vary in size from 25 to 100 ft. in diameter. On the adjoining property of the Electric Point mine the chimneys attained a depth of 800 ft. The ore is high-grade sulphide of lead at depth with the carbonates predominating near the surface. The sulphide shipments run from 73 to 77 per cent lead according to settlement sheets. Thirty cars have been shipped to the smelter since Jan. 4. The company is purchasing a 75-hp. gasoline hoist, 10 by 12-in. compressor and machine drills with which to speed development. New orebins are being erected at the railroad tracks at Boundary.

NEVADA

U. S. S. R. & M. Co. Will Resume Work at Eureka

Plans are being made by the United States Smelting, Refining & Mining Co. to begin development work in its Ruby Hill properties, at Eureka soon. A shipment of twenty carloads of coal is now on the way to the property. A crew of twenty men is clearing the track for delivery of the coal to the mine and doing other preliminary work at the property under the direction of F. A. Otto.

Sinking of the Locan shaft, now about 1,200 ft. deep, will be probably started April 1. The object of the new work will be to explore the deep ground beyond the Ruby Hill fault. Chances of finding this orebody, already productive of millions, are excellent, it is said, as geological conditions as well as well-founded inference are favorable.

For years, it is said, the Richmond mine, one of the U. S. company's group, controlled the world price of lead. At one time 89,000 tons of pig lead was awaiting shipment.

Pioche Shipments

The Union Pacific Railroad management has agreed to repair the railroad from Pioche to the Prince mine and will, on the completion of the work, haul out ore from the Virginia Louise mine, the bins now being full. Shipments will be made at the rate of 150 tons a day, which rate will be increased gradually to 200 tons. Shipments for the week ending March 19 were as follows: Prince Consolidated Mining Co., from Dry Valley, 955 tons and from Bullionville, 650 tons; Combined Metals mine, 405 tons; Bristol Silver Mines Co., 420 tons; total of 2,430 tons.

Ely District More Active

Both Nevada Consolidated Copper Co. and the Consolidated Coppermines Co. in the Ely district advanced the wages of practically all classes of labor 50c. per day, effective March 11. An increased number of men are now working in the district, over fifty miners being added to the force at the Giroux mine last week.

Districts tributary to Ely are now getting considerable attention, the high price of lead is the principal cause of activity. Both the Ward and Hamilton districts are producing lead ore, while Cherry Creek is sending out siliceous silver ore to the Salt Lake smelters.

NEW MEXICO

Mogollon Warehouse Burns

The Mogollon Mines Co., operating at Mogollon, 80 miles north of Silver City, N. M., has sustained a loss of $40,000 through the destruction of its warehouse. Owing to its distance from a railroad the company carried a large stock of supplies and replacements. Operations at the mine were not interferred with. Frank Hitchcock, former U. S. Postmaster General, president of the company, is expected at the mine from New York about April 1.

ARIZONA

Copper Queen Mill Starts

Ore from Sacramento Hill at Bisbee was put through the crushing plant at the new 4,000-ton Copper Queen concentrator recently and it was found that the large blocky material could be crushed at the rate of one 40-ton car per minute. Arthur Crowfoot, who was formerly announced as the superintendent of this mill, will return to Morenci, where he will supervise alterations in the corporation's concentrator there. Ernest Whittnau, now assistant superintendent of the Morenci mill, will be transferred to Warren and will have charge of the new mill, it has been announced. An operating crew is being recruited and it is expected that the first unit will be started April 1.

Shattuck-Arizona Seeks Miners

The Shattuck-Arizona Copper Co., which was the last of the larger properties operating in Bisbee district to resume production, is experiencing difficulty in securing an adequate force of skilled men. Production is retarded. This condition is not unlike that encountered by many other organizations throughout Arizona that are attempting to recruit forces for the resumption of mining. The experienced miner has no difficulty in getting work and the demand is greater than the supply.

COLORADO

New Trustees for Golden Are Expected to Alter Policy of School

Governor Sweet has announced the appointment of Max Ball, of Denver, petroleum engineer; Robert Sayre, of Denver, a mining engineer, and H. C. Smiley, for many years the head of Denver public schools, as members of the Board of Trustees of the Colorado School of Mines. It is generally understood that these appointments mean a reversal of the policies that have been followed by previous boards for the past five years or more, and which were the subject of much unfavorable criticism.

Legislators Treat Mining Interests Well

The interests of Colorado mining men have been favorably considered by the Colorado Legislature, which has been in session since the first of the year, and which will probably adjourn about April 10. A bill to largely increase the tax on metal mines was killed in committee. A bill which would greatly increase the cost of compensation insurance was so amended that it was not objectionable to the metal mine operators. A "blue sky" bill, prepared by the Colorado Metal Mining Association, has passed the Senate and will probably receive favorable consideration in the lower House.

New Smelter Schedule at Leadville

Shippers of lead and "neutral" ores will receive benefit from the new schedule of charges which became effective at the Arkansas Valley smelter at Leadville recently. Readjustment of the charges as affecting silica and iron to benefit shippers having a neutral product is one of the features of the new schedule.

The gold and silver is paid for as before. Lead is paid for on a dry assay at the New York quotation less $1.50 per 100 lb. The base treatment charge is $4 and is effective on ore up to $8 in value. Ore running between $8 and $10 a ton is paid for at 25 per cent of its valuation. From $10 to $50 the charges increase on a graduated scale.

The charge for excess silica is 7c. per unit and the credit for iron is 7c., but not to exceed the charge for silica.

The new schedule is represented as being better for those who have lead ore to ship; the ore on which it works a hardship is that running high in silica and iron. The man with the neutral product gets the full benefit of the lower treatment charge and higher payment on lead.

Preparations for the installation of machinery in the old public sampling works at the foot of Leiter Avenue in California gulch, where the new McClain & Cary process for treating low-grade ores of the district will be given its first test on a commercial basis, are progressing.

MINNESOTA

Steam-Shovel Operations Resumed

Steam-shovel mining will be resumed near Ironton at the Pennington mine of the Tod-Stambaugh Co. on April 1. The operators expect to complete removal this season of all ore remaining available to open pit mining, and are for this reason making an earlier start than usual. Until navigation opens the ore will be stockpiled at surface.

Two steam shovels are employed at the Mahnomen mine by Clement K. Quinn & Co., one stripping overburden from new reserves at the east end of the pit and the other preparing a new approach. Three locomotives are being used hauling seven- and eight-car trains to stripping dumps.

Diamond Drill Prospecting Active

Exploration is more active on the Cuyuna Range than it has been at any time during the past four years. Three diamond drills are being operated on the NE¼ of NE¼ of Section 5, Town 46-29, by the S. E. Atkins Co. This property is expected to reveal the westward extension of the Maroco mine orebody. On Weyerhauser lands in Section 33, Town 47-29, the Adbar Development Co. is drilling for the northwesterly extension of the Maroco ore horizon. The Potts Exploration Co. has started drilling with two rigs on the Cuyuna-Mille Lacs mine property in the south half of SW¼ of Section 3, Town 46-29. The Cuyuna-Mille Lacs mine has a substantial reserve of low phosphorus manganiferous ore as well as some straight iron ore. Mayor Wladimiroff of Crosby is drilling with one rig on lands which he has under option in Atkin County and expects to add other drills later in the season.

JOPLIN-MIAMI DISTRICT

Coyne Plant Ready

The Coyne Land & Zinc Co. expects to have its new mill operating on its lease south of Hockerville, Okla., by April 1. The mine was developed by J. Williams and associates and was taken over by T. F. Coyne, of Webb City, about six weeks ago. He purchased the old Muskogee mill, north of Quapaw, and has been moving and rebuilding it on his lease. In the meantime he has been sinking another shaft, east of the mill, which will be used as an air shaft at first but later on may be used as a field shaft. Two gas engines have been installed to furnish power.

Shipments Exceed Production

Shipments of zinc ore from this field have been steadily larger than average production since the first of the year, with the result that the surplus ore in bins in the field is being cut decidedly. Estimated production for the first eleven weeks of the year was 145,350 tons, while shipments have amounted to 161,644 tons. The Commerce Mining & Royalty Co., which accumulated an ore pile estimated at 35,000 tons at its Webber mine, in Kansas just across the state line from Picher, Okla., has begun to sell since ore reached $45 a ton, and it is expected this pile, which at one time was worth more than $1,600,000, will soon be reduced to small size. During the week ending March 18 the company sold 10,000 tons, or $480,000 worth to the American Metal Co.

MICHIGAN

Copper Sold as Fast as Smelted—Production Regulated by Labor Supply

The heavy demand for Lake copper continues. Shipments from the smelters in the Michigan district exceed 400,000 lb. daily, absorbing the entire output of the mines on the present curtailed basis. Ordinarily at this time of year the smelter docks are filled with metal, awaiting the opening of navigation for shipment down the lakes by boat. Such stocks, however, are not now visible, the copper going out from day to day by rail. Were labor more plentiful, the mining companies would profit greatly with 17c. copper, but limited production due to the labor shortage is depriving the mines of many thousands of dollars. Much more Lake copper than is now being sold could be disposed of if available, smeltermen say.

While there is talk of a further increase in wages in the Michigan district when the price of copper goes up to 18c. per lb., it is unlikely wages will be raised if and until 20c. per lb. can be obtained for the metal. This is stated on the authority of one of the mine managers. While there was no particular enthusiasm over the recent 20 per cent increase, the announcement that wages at the mines in the west and southwest have been increased only 10 per cent has tended to bring about a better feeling in the Michigan district.

THE MARKET REPORT

Daily Prices of Metals

Mar.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
22	17.125	47.50	49.375	8.25	8.20	7.65@8.00
23	17.10	47.125	49.25	8.25	8.20	7.65@8.00
24	17.00@17.12½	46.50	49.00	8.25	8.20	7.60@7.90
26	16.875@17.00	45.50	47.875	8.25	8.175@8.20	7.50@7.80
27	16.875@17.00	45.375	47.50	8.25	8.175	7.50@7.75
28	16.875@17.00	45.875	47.75	8.25	8.175	7.50@7.75

*These prices correspond to the following quotations for copper delivered: March 22d, 17.375c.; 23d, 17.35c.; 24th, 17.25@17.375c.; 26th, to 28th, inc., 17.125@17.25c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin quotations are for prompt deliveries. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

March	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
22	74⅞	75⅝	83	223¾	224¾	28⅜	28⅜	36¾	36¾
23	75⅜	76⅛	83	224	224½	28½	28½	36½	36½
26	73¾	74½	82	216¾	217½	27¾	27⅝	35⅞	36
27	73½	74⅛	81½	213	214½	27¼	27⅜	35¼	35½
28	73⅞	74⅝	81	216	216¾	28¼	28¼	35⅝	35¾

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver			Mar.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
22	4.69	99⅛	67⅜	32½	26	4.68¾	99⅛	68½	32⅜
23	4.69⅛	99⅛	67¾	32 7/16	27	4.68⅝	99⅛	68⅛	32⅛
24	4.68⅝	99⅛	68	32⅜	28	4.68¼	99⅛	68½	32 13/16

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, March 28, 1923

The week has again been a quiet one in the metal trades, with narrow price changes. Prices in London have fluctuated comparatively widely however, and the unrest there has without doubt had an adverse effect on business here. The London market will be closed from Friday to Monday inclusive, for the Easter holidays, and although these are not observed on this side of the water, little increased activity is expected locally before next week. Consumption in practically all lines continues excellent.

Copper

As pointed out in these columns last week, the advance in copper prices from below 17c. to 17⅜c. was not attributable to any important buying by domestic consumers but rather to speculative purchases in the London market. These have now ceased, and with domestic buying still on a small scale, the price has shown a tendency to recede to the 17c., delivered, level. This is not to say that the large producers have come to that level. Most of them are still quoting 17⅜c., but admit doing little or no business. Monday and Tuesday there was a slight break in their ranks, with metal being offered at 17.25c., but it was found that this price was also unattractive, with second-hands willing to sell at 17⅛c. It is true that these second-hands have no large amount of copper to offer, but with the present temper of consumers it is sufficient to supply the demand. Yesterday it was even possible to secure copper for the second half of the year for 17c. delivered. The present lull in copper buying is not abnormal, for buying goes in waves. Producers are well sold up and it is unlikely that they will force their copper on an unwilling market for some weeks, so that no important price recession is likely. It is a fact, however, that the demand for manufactured copper products has weakened since the price went to 17c. The customers of the wire and brass mills seem to be watching the price of raw copper more than they formerly did, and to restrict their buying if they think the price has risen too fast.

The export business for the week has been small, with the dislocation of the London market, but improved today.

Lead

The official contract price of the American Smelting & Refining Co. continues at 8.25c., New York.

Sales have been of small volume for the week, customers sensing the slightly easier condition of the market, and preferring to hold off their purchases as long as possible to see if the more adequate supplies would not be reflected in a drop in price. This was particularly true after the fall in the London market, on Monday. So far, however, the 8.25c. price for April or May delivery is general in the New York market, and premiums are asked for spot metal, of which there is comparatively little sold. Consumption of lead seems to be on as great a scale as ever, though it is possible that the requirements of storage battery makers are falling off slightly. The slight decline in the St. Louis market has been inspired by one large producer who is anxious to see a greater differential between the New York and St. Louis prices. Inquiries in the Middle West for prompt deliveries are somewhat greater than usual, but premiums on near-by deliveries are difficult to obtain. Reports from abroad indicate a pronounced tendency to increase Spanish production, and as France is not taking much lead, this may throw additional supplies on the London market.

Zinc

The zinc market has also been exceptionally quiet. Sales are well distributed over deliveries from March to August, with the higher prices being asked for spot and near-by metal. The slight decline in price has been inspired

by the fall in London, enabling international traders to buy back metal there and release it here. Consumption continues on a good scale, and the stocks available, and the current production, do not warrant a weakening in price. The price range in the week to come will depend largely on London. High-grade zinc continues unchanged at 8.75 @9c. delivered in the East.

Tin

The price has fluctuated violently in London, and yesterday the low levels attracted a few consumers on this side. Tin-platers, however, continue largely out of the market. Forward deliveries have sold for ¼c to ⅜c. less than spot.

Arrivals of tin, in long tons: March 20th, Liverpool, 50; 24th, Straits, 10; 26th, Australia, 50; London, 250; 27th, London, 50; total so far in March, 6,652.

Gold

Gold in London: March 22d, 87s. 10d.; 23d, 87s. 9d.; 26th, 87s. 10d.; 27th, 87s. 10d.; 28th, 88s. 2d.

Foreign Exchange

On Tuesday, March 27th, cable quotations on francs were 6.535c.; lire, 4.9325c.; marks, 0.0048¼c.; and Canadian dollars, 1⅞ per cent discount.

Silver

Silver made new high levels for the year on the 26th and again on the 27th in both London and New York.

Chinese buying was responsible for the advance, and although a slight reaction occurred on March 28th, the market closes firm.

Mexican Dollars—March 22d, 51⅜; 23d, 51¾; 24th, 52; 26th, 53⅜; 27th, 52⅜; 28th, 52½.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—General market for 99 per cent grade, 25½@26c. per lb.; 98 per cent, 24½@25c. London quotations, £92@£105.

Antimony — Chinese and Japanese brands, 9@9¼c. W.C.C., 9½c. Cookson's "C" grade, spot, 9¾@10¼c. Chinese needle antimony, lump, nominal, 6c. per lb. Standard powdered needle antimony, 200 mesh, at 6½@7c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 8½@9c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium — $1.10 per lb. London quotes 4s. 6d. @ 5s. 6d.

Iridium—$260@$275 per oz.

Nickel—25@30c. per lb. for 99 per cent virgin metal.

Monel Metal—Shot and blocks, 32c. per lb.; ingots, 38c.; f.o.b. W. Va.

Osmium—$80@$85 per oz., Los Angeles.

Palladium—$79 per oz.

Platinum—$112 per oz. London, £22½.

Quicksilver—$72 per 75-lb. flask. San Francisco wires $70.15. London £12 5s.

Ruthenium—$40@$45 per oz.

Selenium—$2 per lb.

The prices of Cobalt, Molybdenum, Radium, Rhodium, Tellurium and Thallium are unchanged from prices given March 3.

Metallic Ores

Chrome Ore—Indian chrome ore, $20.50 per ton, c.i.f. Atlantic ports. Rhodesian and New Caledonian, $24@$26 per ton.

Manganese Ore—40@45c. per long ton unit, seaport, plus duty.

Molybdenum Ore—75@85c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates.

Tungsten Ore — Wolframite, $8@$8.50; scheelite, $8.50@$9 per unit of WO_3 f.o.b. New York.

Iron Ore, Magnetite, Tantalum, Titanium, Uranium, Vanadium, and **Zircon Ore** are unchanged from the quotations published March 3.

Zinc and Lead Ore Markets

Joplin, Mo., March 24—Zinc blende, per ton, high, $52.60; basis 60 per cent zinc, premium, $51@$51.50; Prime Western, $48.50@$50; fines and slimes, $48@$45; average settling price, all grades of blende, $48.13; calamine, basis 40 per cent zinc, $30@$32; average, $30.30.

Lead, high, $123.75; basis 80 per cent lead, $122.50; average, all lead, $118.30 per ton.

Shipments for the week: Blende, 19,228; calamine, 180; lead, 1,626 tons. Value, all ores the week, $1,113,620.

Purchases of 11,670 tons this week was a drop of 19,340 tons from the tonnage purchased last week. Sellers demanded $50 basis, and many buyers were instructed to accept no ore on that basis for Prime Western grades. The basis price of $51.50 was paid for lead-free ore. A cable dispatch received locally, indicating a weakening of foreign demand, may be the cause of smelters declining to further advance ore prices.

Platteville, Wis., March 23.—Blende, basis 60 per cent zinc, $53 per ton. Lead, basis 80 per cent lead, $120 per ton. Shipments for the week: Blende, 331 tons; lead, none. Shipments for the year: Blende, 8,411; lead, 145 tons. Shipments for the week to separating plants: 181 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, $500; No. 2, $250@$325; long spinning fibers, $135@$200; magnesia and compressed sheet fiber, $100@$150; shingle stock $65@$85; paper stock, $35@42; cement stock, $20@$25; shorts, $9@$14—all per short ton, f.o.b. mines, Quebec, Canada.

Rhodesian No. 1 crude, $375; No. 2, $250; inferior grade, $200—all c.i.f. Atlantic ports per short ton.

Magnesite — Dead-burned magnesite grains, $40 per net ton, f.o.b. Baltimore; $40@$42, Chester, Pa.

Crude, $14 per ton; 85 to 90 per cent MgO calcined lump, $32.50@$38 per ton; calcined ground, in paper sacks, 90 per cent through 200 mesh, $44@$48 per ton—all f.o.b. California points.

Grecian caustic-calcined and ground, $51@$52 per ton, f.o.b. cars, Atlantic seaboard.

Bauxite, Barytes, Chalk, China Clay, Diatomaceous Earth, Emery, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, and **Tripoli** are unchanged from the March 3 prices.

Mineral Products

Arsenious Oxide (white arsenic)—14@15c. per lb. for prompt, nominal. June, 12½c. 2d half 1923, 11c.

Sodium Sulphate—$26@$28 per ton.

Potassium Sulphate, Sodium Nitrate, and **Copper Sulphate** are unchanged from quotations of March 3.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $120 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $40, f.o.b. furnace; 16@19 per cent, $39.

Ferrosilicon—50 per cent $86@$89 per gross ton, delivered.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrotitanium, Ferrotungsten, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published March 3.

Metal Products

Copper Sheets—Base price 25½c. per lb. Wire, 19⅜c.

Nickel Silver—30⅜c. per lb., for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 22½c. per lb.; rods, 19½c. per lb.

Zinc Sheets—Base price, $10 per 100 lb., East St. Louis.

Lead Sheets—Full, $10.25; cut, $10.50 per 100 lb.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the March 3 prices.

The Iron Trade

Pittsburgh, March 27, 1923

Production of steel continues at a high rate, the highest since the armistice, and perhaps above the best rate during the war. Serious labor shortage is to be expected in spring, but no great decrease in production is to be expected.

The minimum price on shapes and plates, for late delivery, is 2.35c., against 2.25c. formerly. There is more premium business being done in plates, bars, sheets and other products than formerly, and the premiums are greater.

Guesses are now being made that the excitement in the steel market will begin to wane in a few weeks as a result of the heavy deliveries mills are making, but heavy production seems assured for months.

Pig Iron—Basic and foundry have followed bessemer in an advance from $30 to $31, Valley, and $32 is now predicted as a probability in a few days.

Connellsville Coke—$7.50@$7.75 for spot or contract furnace, foundry being $8.25@$9 for spot.

Exports of Ores and Metals in January, 1922 and 1923

Exports of copper, lead, and zinc during January, 1923, with revised comparative figures for January, 1922, as compiled from the returns to the Bureau of Foreign and Domestic Commerce, are as follows:

Exports of Copper, Lead and Zinc

In Pounds

	January 1922	January, 1923
Copper		
Ores, concentrates and unrefined (copper content)	62,142	3,659
Copper and manufactures of (total)	54,777,776	76,859,283
Refined, in ingots and bars	50,096,680	64,286,337
Exported to		
Belgium	3,405,727	3,174,204
France	7,985,565	15,021,273
Germany	16,289,741	21,593,398
Italy	4,428,122	5,974,785
Netherlands	728,831	2,825,166
Spain	1,199,511	1,195,570
Sweden	897,029	1,157,059
United Kingdom	2,756,851	9,410,099
Canada	113,299	671,611
China	2,073,072	2,396,800
Japan	9,961,095	.....
Other countries	257,837	866,372
Old and scrap	796	621,928
Composition metal, copper chief value	2,959	1,840
Pipes and tubes	78,925	138,492
Plates and sheets	226,106	228,921
Wire except insulated	391,925	1,171,494
Insulated wire and cable	1,115,074	887,349
Lead		
Pigs and bars		
From domestic ore	938,438	112,040
From foreign ore	11,485,171	8,184,558
Exported to		
France	7,520,495	2,240,990
Germany	784,306	1,100,226
Netherlands	224,075	918,713
United Kingdom	1,792,460	3,965,934
Argentina	224,032	.....
Brazil	560,084	.....
Other countries	1,318,157	70,735
Other lead manufactures	582,510	605,078
Zinc		
Ore, concentrates and dross	911,090	2,016,929
Spelter		
From domestic ore	1,688,144	24,091,269
From foreign ore	85,676	1,337,828
Total zinc slabs, blocks, etc.	1,773,820	25,429,097
Exported to:		
France	795,306	3,088,319
United Kingdom	.....	20,395,457
Canada	72,000	215,043
Japan	112,010	.....
Other countries	794,504	1,730,278
In sheets and strips	384,178	837,595
Zinc dust	499,729	562,995
Other zinc manufactures	11,374	196,811

Mining Dividends in March

The following dividends were paid by mining and metallurgical companies during March:

Companies in the United States	Situation	Per Share	Total
Ahmeek, c	Mich.	$1.00 Q	$200,000
American Metal	U. S. and Mex.	0.75 Q	402,000
American Metal pfd	U. S. and Mex.	1.75 Q	87,500
American Smelting & Ref. pfd	U. S. and Mex.	1.75 Q	875,000
Butte Copper & Zinc, z.l.s.	Mont.	0.50 K	300,000
Calumet & Arizona, c	Ariz.	1.00 Q	642,522
Calumet & Hecla, c	Mich.	7.00 Q	700,000
Federal Mining & Smelting pfd s.l.	Idaho	1.75 Q	210,000
Hecla Mining, s.l.	Idaho	0.25 QX	250,000
Homestake, g	S. D.	0.50 M	125,580
Inland Steel	Minn.	0.25 Q	251,752
Isle Royale, c	Mich.	0.50 Q	75,000
Mohawk, c	Mich.	1.00 TY	100,000
National Lead	U. S.	2.00 Q	413,108
National Lead pfd	U. S.	1.75 Q	426,433
Osceola, c	Mich.	1.00 Q	96,150
St. Joseph Lead	Mo.	0.50 Q	774,684
St. Mary's Mineral Land, c	Mich.	3.00 K	480,000
Silver King Coalition, s.l.	Utah	0.15 K	182,415
Tamarack & Custer, s.l.	Idaho	0.02 K	100,000
Texas Gulf Sulphur	Texas	1.25 Q	793,750
Tintic Standard, s. l.	Utah	0.10 Q	117.470
U. S. Steel	U. S.	1.25 Q	6,353,781
United Verde Copper	Ariz.	1.50 Q	450,000
Utah Copper	Utah	1.00 Q	1,624,490
West End Consolidated, s.g.	Nev.	0.05 Q	89,424
Companies outside of the United States			
Chile Copper	Chile	0.625 K	2,375,000
Hollinger Consolidated Gold	Ont.	0.05 4 wks	246,000
Keeley Silver Mines	Ont.	0.08 K	160,000
La Rose Mines, s	Ont.	0.10 K	150,000
Lucky Tiger-Combination, g	Sonora	0.07 M	50,074
Oroville Dredging, g	Colombia	9d. K	£26,836

Q, quarterly; K, irregularly; TY, every four months; X, includes 10c. extra; M, monthly; c, copper; s, silver; l, lead; z, zinc; g, gold.

Several increases over the December disbursements are noticeable reflecting improved conditions in the metal industries.

Imports of Ores and Metals in November, 1921 and 1922

Imports of certain of the metals and ores during November, 1922, with revised comparative figures for November, 1921, as compiled from the returns to the Bureau of Foreign and Domestic Commerce, are as shown in the following table. November figures are only just available because of the difficulties incident to the calculation of duties under the new tariff act.

Imports, November

In Pounds Unless Otherwise Stated

	November 1921	November 1922
Antimony		
Ore	.....	.....
Metal, matte and regulus	1,545,895	851,424
Copper and brass		
Ore	5,669,284	14,348,988
Concentrates	1,414,356	4,820,633
Regulus, coarse metal and cement copper	213,943	548,780
Total	7,297,583	19,718,401
Imported from		
Spain	1,003,920	224,800
Canada	419,716	490,356
Mexico	45,706	3,110,800
Cuba	2,187,558	3,614,415
Chile	2,833,889	10,600,395
Colombia	.....	161
Peru	82,560	272,081
Venezuela	514,291	544,281
Other countries	209,943	.861,112
Unrefined black, blister and converter copper in pigs and bars	10,561,454	44,662,154
Imported from		
Spain	.....	5,212,418
United Kingdom	.....	5,504,551
Canada	97,611	2,367,064
Mexico	1,369,682	4,002,135
Chile	4,736,085	6,042,629
Peru	4,014,937	8,645,949
Portuguese Africa	.....	12,575,888
Other countries	343,139	311,520
Refined copper	7,825,099	10,567,562
Old and clippings for remanufacture	2,091,382	498,697
Composition metal, copper chief value	47,762	157,891
Copper manufactures	.....	21,619
Brass		
Old and clippings for remanufacture	8,516,832	6,899,223
Manufactures of brass	.....	53,195
Lead		
Ore and matte	928,773	6,801,115
Bullion or base bullion	12,197,411	11,471,616
Pigs, bars, other forms and old	2,916,234	301,158
Manufactures of lead (except type metal)	.....	20,261
Manganese ore, long tons	8,620	.....
Tungsten ore, long tons	83	.....
Pyrites, long tons	28,057	19,334
Tin and zinc		
Tin ore	.....	685,168
Tin in bars, blocks and pigs	6,886,085	8,944,136
Imported from:		
United Kingdom	478,220	874,325
China	.....	694,969
British Straits Settlements	5,828,407	5,912,880
Dutch East Indies	111,989	57,177
Hongkong	225,379	1,371,954
Australia	197,120	.....
Other countries	44,970	32,831
Zinc ore (free)	.....	238,107
Zinc in blocks and pigs	.....	8,818
Zinc dust and manufactures of	.....	5,313

Value of Aluminum Output Increases

The value of the new aluminum produced in the United States in 1922, reported by the producers to the U. S. Geological Survey, was $13,622,000, an increase of about 25 per cent over the value in 1921.

Figures showing the imports for the last three months of 1922, since the passage of the new tariff law, have not yet been compiled. The imports of aluminum in crude form, scrap, and alloys of any kind in which aluminum is the material of chief value, for the first nine months of 1922, amounted to 31,482,893 lb., compared with 26,177,852 lb. for the corresponding period in 1921. Articles made of aluminum valued at $1,486,177 were imported during the first nine months of 1922, compared with articles valued at $1,635,106 imported during the corresponding period of 1921.

In 1922 the exports from the United States included 1,538,079 lb. of ingot and scrap aluminum and alloys containing aluminum, 2,808,946 lb. of plates, sheets, bars, strips, and rods, and 4,548,939 lb. of manufactured articles. In 1921 the exports included 301,951 lb. of ingot, bars, strips, and rods, 499,124 lb. of sheets, and like forms, and 2,307,782 lb. of manufactured articles.

COMPANY REPORTS

Premier Gold Mining Co., Ltd.

Silver, Gold; British Columbia

A report of operations of the Premier Gold Mining Co. for 1922 gives the following data:

Value of ore sold:		
Liquidations received	$3,785,210.66	
Liquidations not received	997,674.77	
		$4,782,885.43
Operating and miscellaneous expenses		1,022,506.64
Earnings from mine operations		$3,760,378.79
Interest, exchange, discounts, rents		226.43
Total earnings		$3,760,605.22
Deduct:		
Administrative expenses	$6,886.33	
Taxes (income taxes estimated)	368,909.30	
Depreciation	129,937.87	
Depletion	1,815,416.41	2,321,149.91
Balance of income for year		$1,439,455.31
Profit and loss deficit Dec. 31, 1921		65,818.54
Balance of profits available for dividends		$1,373,636.77
Dividends declared this year		2,773,125.00
Accrued from earnings	$1,373,636.77	
Return of capital accrued through reserve accounts set up for ore depletion and depreciation	1,399,488.23	
		$2,773,125.00

Assets

Mining property, buildings and equipment	$6,963,058.93	
Less depletion and depreciation	2,688,277.84	$4,274,781.09
Investment in capital stock of B. C. Silver Mines, Ltd.		129,454.12
Current assets		
Material and supplies	$206,102.78	
Ore sold, in process of liquidation	997,674.77	
Accounts collectible	130,024.12	
Cash	257,025.91	1,590,827.58
		$5,995,062.79

Liabilities

Capital stock, par	$5,000,000.00	
Plus capital surplus	1,246,829.84	
Less capital distribution	1,399,488.23	
Balance		$4,847,341.61
Current liabilities		
Current accounts payable	$92,668.43	
Accrued taxes not yet due	299,944.82	
Dividend No. 5 payable Jan. 3	750,000.00	1,142,613.25
Miscellaneous suspense accounts		5,107.93
		$5,995,062.79

"Production amounted to 127,827 oz. of gold and 4,474,367 oz. of silver. A conservative estimate of the general average of the 73,000 tons broken in stopes as at Dec. 31, 1922, is: 0.72 oz. gold and 32.0 oz. silver per ton. With gold figured at $20 per oz. and with silver at 65c., this represents a gross value of $35.20 per ton. A conservative estimate of the assured and probable unbroken ore to the bottom level of the present mine workings is 300,000 tons, averaging 0.71 oz. gold and 27.0 oz. silver per ton. With silver at 65c. this represents a gross value of $31.75 per ton.

"The orebodies of the Premier within the area of the present workings have maintained their widths to the present bottom level and in fact have widened somewhat, the average width on the bottom level being around 15 ft. and with a length, as far as opened up, of approximately 500 ft. The average value of the ore has, however, dropped to a milling grade on the bottom level, the value there being approximately 0.32 oz., gold, 5 oz., silver and although no development other than by diamond drilling has been done below the bottom level, six diamond drill holes, cutting the orebody at various points to a depth of about 100 ft. below the bottom level, have shown a continuance of approximately the same average grade.

"The foregoing tonnage estimates do not represent the total probable tonnage from the Premier property, but refer to the total probable tonnage within the limits of the present mine workings. There is some 600 ft. of unexplored ground to the eastward of the present mine workings and along the same ore zone. Also there are possibilities southwestward of the same zone and there are various surface showings elsewhere upon the property. . . .

"It is desired, however, to make clear to all the stockholders that the very high-grade ore—due doubtless largely to secondary enrichment—within the limits of the present mine workings, does not, judging from the results of development work to date, live down much, if any, below the point at which the third level is now being started, about midway between the second and the bottom or fourth level, this No. 3 level being approximately 600 ft. vertically below the surface.

"Should the southwestern trend of the Premier orebodies, beyond the present mine workings be found by further development and exploration to carry commercial orebodies, it is possible that these bodies may show high-grade ore at points below the present bottom level. Due to the surface contour, the ground sloping toward the southwest, and upon the southwestern trend some 2,000 ft. within the limits of the Premier's property, remains unexplored."

The Exploration Co., Ltd.

Gold, Copper; Mexico

A report of operations of the Exploration Co., Ltd., for the year ended Dec. 31, 1922, shows a net realized profit of £18,497 10s. 2d. which, added to the balance of £97,016 8s. 1d. brought forward from the preceding year, makes a total of £115,513 18s. 3d. to the credit of profit and loss.

From this the directors have transferred a sum of £67,110 15s. 9d. to a reserve account to provide for depreciation on the shares and interests of the company, which stand in the balance sheet at a book cost of £306,508 10s. On the basis of market prices for quoted securities and directors' valuation for unquoted securities, this depreciation amounted on Dec. 31, 1922, to the above £67,110 15s. 9d.

After thus providing in full for depreciation there remains in the profit-and-loss account a credit balance of £48,403 2s. 6d., out of which the directors recommend the payment of a dividend of 10 per cent (being 1s. per share, free of income tax, absorbing £36,064 18s.), leaving a balance to credit of profit-and-loss account of £12,338 4s. 6d. to be carried forward.

The issued capital of the company has been reduced to £360,649 in 721,298 shares of 10s. each, by the purchase of 28,702 shares from the public trustee.

The Buena Tierra Mining Co.—During the past year the local administration of this company was reorganized, regular shipments of ore to the smelter have been resumed, and the proceeds have been sufficient to meet all costs.

The Santa Rosa Mining Co.—This mine, upon which operations had been suspended for nine years, has been reopened. During the ten months ending December last, shipments of selected ore were made to the smelter, the net profits therefrom being sufficient to discharge all outstanding liabilities in Mexico, and to defray a considerable and exceptional expenditure in technical and metallurgical investigation, and the cost of re-conditioning the mine and its further development.

The El Oro Mining & Ry. Co. was able to maintain its dividend distribution of 1s. per share during the last year, notwithstanding the heavy burden of taxation in Mexico, which, being levied upon gross output, bears with special severity on low-grade mines such as the El Oro.

Elbow Lake.—This adventure in Manitoba, referred to at the last meeting, has been abandoned. Early developments on the surface were highly encouraging, but were not confirmed by exploration in depth.

Bingham Mines Co.

Lead, Silver; Utah

A report of the operations of the Bingham Mines Co. for 1922 shows a net operating gain of $175,781.29, as follows:

Gross income		
Ore shipments	$790,399.91	
Royalties	32,760.25	
Rents	1,930.65	
		$825,090.81
Expenses		
Smelting, freight, sampling and assaying	$307,219.61	
Mine operations	185,180.10	
Management, office, legal, taxes	36,960.67	
Insurance and miscellaneous taxes	38,607.60	
		567,967.98
		$257,122.83
Prospecting and development of mines		81,341.54
Net operating gain		$175,781.29

Profit-and-Loss Account

Net operating gain	$175,781.29	
Interest	1,625.89	
Total credits		(a) $177,407.18
Construction and depreciation	$7,834.13	
Mine depletion	116,222.82	
Total debits		124,056.95
Balance to earned surplus		$53,350.23
Earned surplus balance, Dec. 31, 1921		573,461.75
Earned surplus balance, Dec. 31, 1922		$626,811.98

(a) Does not include dividends amounting to $62,191.75 received from mining stocks "as return of capital."

Balance sheet as of Dec. 31, 1922, is given as follows:

Assets

Real estate and mines		$1,312,402.37
Construction and equipment		46,252.48
Mining stocks	$994,613.05	
Less—"return of capital" dividends	400,292.30	
		594,320.75
Bingham Mines Co. stock (purchase of 64,969 shares)		732,004.60
Prepaid insurance and other expenses		461.80
Supplies at mines		7,835.87
Accounts receivable (subsidiary companies)		34,768.98
Accounts receivable (miscellaneous)		8,396.16
Notes receivable (subsidiary companies)		156,120.30
Cash and receivables		72,761.40
		$2,965,324.71

Liabilities

Capital stock (150,000 shares)	$1,500,000.00
Accounts payable (including federal taxes)	13,238.17
Reserve for depreciation	97,114.20
Reserve for depletion (3/1/13 to 12/31/22)	728,160.36
Earned surplus	626,811.98
	$2,965,324.71

Earnings for the year from mining operations were $177,407.18, and dividends received from the Eagle & Blue Bell Mining Co. amounted to $62,191.75, making the total net gain and income of $239,598.93, or an increase of $75,273.67 over the previous year. There was also $81,341.54 spent in prospecting and development of the mines.

During the year the company acquired stock of the American Star Mining Co. as follows: as dividend from Eagle & Blue Bell Mining Co., 378,403 shares, and purchased 12,817 shares, a total of 391,220, or 55.4 per cent of the outstanding stock. This property is in the Tintic district adjoining the Chief Consolidated Mine, and is being operated through the Eagle & Blue Bell. Recently a good grade of ore has been opened in the mine, and the prospects are favorable, according to the report. There were purchased during the year 10,122 shares of this company's stock, reducing the outstanding stock to 85,031 shares.

The percentage of Eagle & Blue Bell Mining Co. stock owned by this company is now 96.9 per cent.

Production from the subsidiary units of the company was as follows:

	Lead, Lb.	Silver, Oz.	Gold, Oz.	Copper, Lb.
Victoria	4,483,992	480,922	1,187.1	16,975
Eagle & Blue Bell	3,876,588	390,490	1,163.5	.....
Dalton & Lark and Commercial	369,562	63,884	929	240,886
American Star	.....	20,981	65	11,827
Yosemite	83,304	2,063	12.8	.....

Facts for the Stockholder

XI—Homestake Mining Co.

The Homestake Mining Co. was incorporated in California, in November, 1877, to take over the Grant and Old Abe claims, located by J. B. Pearson in 1875. In 1899, the adjoining property of the Highland Mining Co. was acquired, consisting of about seventy-three acres, and the properties of the Black Hills Canal & Water Co., including forty miles of ditches, flumes, pipe lines, reservoirs, and water rights covering the water supply of the Deadwood and Lead districts. Property now owned by the company includes 468 claims in the White Wood mining district, near Lead, S. D., consisting of about 3,723 acres.

The orebody is a mass of silicified slate, several hundred feet thick, about half a mile wide, and several miles long. Average assays range from $3.75 to $6 gold a ton. The ore has been mined to a depth of about 1,700 ft. The ore is variable in composition, but the unoxidized ore in the deeper levels usually contains chlorite or ferruginous hornblende, with quartz, lime carbonates, and sulphides. Sulphides vary in amount from 3 to 5 per cent, and carry about $4 gold a ton. Over 60 per cent of the ore is free-milling.

Development is by six principal shafts, varying in depth from 800 to 2,195 ft. Total underground workings aggregate about 130 miles. During recent years, development work has been carried on at the rate of 6,000 to 24,000 ft. per annum. The reserve of broken ore in the stopes amounts to about 1,200,000 tons, or a little under a year's supply for the mills.

The ore has been treated in six different mills, equipped with over 1,000 stamps, amalgamating plates, and cyanidation equipment for sand and slime. The mills have been remodeled and improved from time to time and kept up to date. The latest important addition to the milling equipment is the new South mill, construction of which was begun in 1921. Tonnage treated annually has varied from 1,200,000 to 1,600,000 tons. Power equipment includes hydro-electric plants at Spearfish and Englewood, and a steam-driven electric generating station at Lead. The company operates its own machine shops, carpenter shops, and foundry.

Capital stock authorized and outstanding consists of 251,160 shares, par value $100. There is no funded debt. At the beginning of 1922, mining properties, and mining and milling equipment, was valued at $28,558,000. Current assets were $1,984,000, with current liabilities at $285,000, leaving net working capital of nearly $1,700,000. Net assets applicable to capital stock amounted to about $96 a share.

During recent years, after deducting from gross revenue the usual operating expenses, the company has set aside large sums for depreciation and depletion reserves. Deductions for depreciation have varied from $563,000 to $645,000 per annum, and for depletion $324,000 to $843,000 per annum. After these deductions during the last five or six years, the earnings have averaged about $4.40 a share for the ten years ended with 1921.

Dividends have been paid in every year since 1879, excepting 1920. Dividends are declared monthly, and are payable on the 25th to stockholders of record the 20th of each month. Payments were suspended in May, 1907, on account of fire in the mines, and were resumed in January, 1908; and were again suspended in December, 1909, owing to labor troubles, and resumed in March, 1910. The present dividend rate is $6 per annum, having been increased from $3 per annum in November, 1922.

Disbursements in recent years have been as follows: $5 in 1910, $6 in 1911-12, $8.80 in 1913-16, with a 15 per cent stock dividend in March, 1913; $7.80 in 1917, $6 in 1918, $4.50 in 1919, nothing in 1920, $2 in 1921, having been resumed at the rate of 25c. monthly, in May, 1921.

The management is unusually conservative from the stock-market standpoint and there is not a wide interest in the stock. Last year only 29,400 shares were sold on the New York Exchange.

Price range of stock during the last ten years has been as follows: High, 135½, in 1916; low, 45, in 1920; closing price, 70, March 28, 1923. INVESTIGATOR.

MINING STOCKS

Week Ended March 24, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	85	80	81½	Mar. 23, Q	$1.00
Alaska-Br. Col.	N. Y. Curb	2⅜	2¼	2⅜	.....	....
Alloues	Boston	31	28½	29½	Mar. '19	1.00
Anaconda	New York	52¼	50¼	51	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3 1/16	3	3¼	.....	....
Ariz. Com'l.	Boston	14	13½	13⅝	Oct. '18, Q	0.50
Bingham Mines	Boston	18	17⅜	17½	Sept. '19, Q	0.25
Calaveras	N. Y. Curb	3¾	3⅝	3⅝	.....	....
Calumet & Arizona	Boston	...	...	62½	Mar. '23,	1.00
Calumet & Hecla	Boston	395	376	376	Mar. '23, Q	7.00
Canada Copper	N. Y. Curb	*5	*3	*4	.....	....
Centennial	Boston	12½	11¼	12	Dec. '18, SA	1.00
Cerro de Pasco	New York	48½	47	47	Mar. '21, Q	0.50
Chile Copper	New York	29⅝	28⅜	28⅝	Mar. 23,	0.625
Chino	New York	31⅝	29⅜	29½	Sept. '20, Q	0.37
Copper Range	Boston	44	43½	43½	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1½	1 1/16	1⅛	.....	....
Davis-Daly	Boston	4¼	4	4¼	Mar. '20, Q	0.25
East Butte	Boston	11	10	10½	Dec. '19, A	0.50
First National	Boston Curb	*67	*60	*60	Feb. '19, SA	0.15
Franklin	Boston	2½	2⅜	2½	.....	....
Gadsden Copper	N. Y. Curb	*80½	*80⅜	*80	.....	....
Granby Consol.	New York	33	29⅞	31½	May '19, Q	1.25
Greene-Cananea	New York	32	31⅜	31½	Nov. '20, Q	0.50
Hancock	Boston	3½	3	3	.....	....
Howe Sound	N. Y. Curb	4⅜	3½	3⅝	Jan. '21, Q	0.05
Inspiration Consol.	New York	41⅜	39¾	40	Oct. '20, Q	1.00
Iron Cap	Boston Curb	8	7⅜	8	Sept. '20, K	0.25
Isle Royale	Boston	31½	29½	29¼	Mar. '23, Q	0.50
Kennecott	New York	43¾	41½	41⅝	Jan. '23, K	0.75
Keweenaw	Boston	2	2	2	.....	....
Lake Copper	Boston	4⅜	4½	4½	.....	....
Magma Copper	New York	38	35½	35½	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	2⅛	2¼	2⅛	.....	....
Mass Consolidated	Boston	3½	3	3	Nov. '17, Q	1.00
Miami Copper	New York	29½	28½	29	Feb. '23, Q	0.50
Michigan	Boston	4	2⅞	2⅞	.....	....
Mohawk	Boston	66	63	63	Mar. '23, Q	1.00
Mother Lode Coa	New York	13½	12⅜	12⅞	Mar. '23, K	0.50
Nevada Consol.	New York	17⅛	16⅛	16½	Sept. '20, Q	0.25
New Cornelia	Boston	24	22	22½	Feb. '23, Q	0.25
North Butte	Boston	11⅜	10½	10½	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*94	*78	*81	.....	....
Old Dominion	Boston	30½	29½	29½	Dec. '18, Q	1.00
Osceola	Boston	43	40	41½	Mar. '23, K	1.00
Phelps Dodge	Open Mar.	†185	†175	...	Jan. '23, Q	1.00
Quincy	Boston	49	45	46½	Mar. '20, Q	1.00
Ray Consolidated	New York	16⅛	15⅛	15⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	2⅛	1⅞	1⅞	.....	....
St Mary's Min. Ld.	Boston	52	50	51	Mar. '23, K	3.00
Seneca Copper	Boston	...	...	11¼	.....	....
Shannon	Boston	1	*80	*91	Nov. '17, Q	0.25
Shattuck Arizona	New York	10	9⅛	9⅛	Jan. '20, Q	0.25
South Lake	Boston	*70	*50	*50	.....	....
Superior & Boston	Boston	2⅜	2⅛	2⅛	.....	....
Tenn. C. & C. cfs.	New York	12⅛	12	12⅛	May '18, I	1.00
Tuolumne	Boston	*48	*45	*45	May '13,	0.10
United Verde Ex.	N. Y. Curb	37⅛	36	37⅛	Nov. '22, Q	0.25
Utah Consol.	Boston	2⅜	2⅛	2⅛	Sept. '18,	0.25
Utah Copper	New York	74⅜	72⅛	72⅛	Mar. '23, Q	1.00
Utah Metal & T.	Boston	1⅛	1⅛	1⅛	Dec. '17,	0.30
Victoria	Boston	2	2	2	.....	....
Winona	Boston	1⅛	1⅛	1⅛	.....	....
Wolverine	Boston	12	11	11	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	15⅛	14⅛	14⅛	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	...	...	75	Feb. '23, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	5⅛	5	5	.....	....
National Lead	New York	136⅜	130	132½	Mar. '23, Q	2.00
National Lead, pfd.	New York	112¼	111⅛	112	Mar. '23, Q,	1.75
St. Joseph Lead	New York	22	21	21	Mar. '23, Q,X	0.50
ZINC						
Am Z. L. & S.	New York	18	17½	17½	May '20,	1.00
Am. Z. L. & S. pfd.	New York	56	56	56	Nov. '20, Q	1.50
Butte C. & Z.	New York	10⅜	9⅜	10	Mar. '23,	0.50
Butte & Superior	New York	36	33⅜	33⅜	Dec. '22,	0.50
Callahan Zn-Ld	New York	11⅜	10⅛	10½	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	180⅛	178½	180	Feb. '23, Q	2.00
United Zinc	N. Y. Curb	...	...	...	.....	....
Yellow Pine	Los Angeles	*58	*57	*58	Sept. '20, Q	0.03
SILVER						
Alvarado	N. Y. Curb	6½	6⅛	6⅛	.....	....
Batopilas Mining	New York	⅜	⅜	⅜	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*50	*46½	*49½	May '20, K	0.03
Candelaria	N. Y. Curb	*30	*22	*27	.....	....
Castle-Trethewey	Toronto	*29	*27	*29	.....	....
Coniagas	Toronto	...	...	2.15	May '21, Q	0.12½
Crown Reserve	Toronto	*64	*49½	*62	Jan. '17,	0.05
Hilltop-Nev.	N. Y. Curb	1½	1⅜	1⅜	.....	....
Kerr Lake	N. Y. Curb	3⅛	3	3⅛	Jan. '23, Q	0.12½
La Rose	Toronto	*31	*29	*30	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*25½	*22½	*25½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	3.25	2.55	3.25	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅛	6	6⅛	Jan. '23, Q,X	0.60
Ontario Silver	New York	...	...	6½	Jan. '19, Q	0.50
Temiskaming	Toronto	*40	*33½	*39	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅜	⅛	⅜	.....	....
Alaska Juneau	New York	1⅜	1¼	1⅜	.....	....
Carson Hill	Boston	8⅞	8	8	.....	....
Creason Consol. G.	N. Y. Curb	2⅜	2⅛	2 1/16	Jan. '23 Q	0.10
Dome Mines	New York	43½	41¾	43	Jan. '23, Q	0.50
Golden Cycle	Colo. Springs	1.05	1.03	1.05	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	13.60	13.45	13.60	Mar. '23, M	0.05
Homestake Mining	New York	70½	70	70½	Mar. '23, M	0.50
Kirkland Lake	Toronto	*60	*54	*60	.....	....
Lake Shore	Toronto	3.60	3.48	3.48	Nov. '22, Q	0.02
McIntyre- Porcupine	New York	20	18⅜	19	Jan. '23, K	0.25
Portland	Colo. Springs	...	...	*35	Oct. '20, Q	0 01
Teck Hughes	N. Y. Curb	1⅛	*99	1 1/16	.....	....
Tom Reed	Los Angeles	1.15	1.11	1.13	Dec. '19,	0.02
United Eastern	N. Y. Curb	2¼	2⅛	2⅛	Jan. '23, Q	0.15
Vipond Cons.	Toronto	...	...	*75	.....	..
White Caps Mining	N. Y. Curb	*11	*11	*11	.....	....
Wright-Hargreaves	Toronto	3.60	3.38	3.54	Jan. '23,	0.02½
Yukon Gold	N. Y. Curb	*95	*90	*92	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*20	*12	*20	.....	....
Cons. Virginia	San Francisco	*14½	11½	12½	.....	....
Continental Mines	N. Y. Curb	5⅛	5⅛	5⅛	.....	....
Dolores Esperanza	N. Y. Curb	2½	1⅞	2	Jan. '23	2.50
Tonopah Belmont	N. Y. Curb	1 7/16	1⅜	1⅜	Jan. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*77	*73	*77	.....	....
Tonopah Extension	N. Y. Curb	3 11/16	3½	3 5/16	Jan. '23, Q	0.05
Tonopah Mining	N. Y. Curb	2⅛	2 1/16	2 1/16	Jan. '23, SA,	0.15
Unity Gold	N. Y. Curb	5⅛	5	5⅛	.....	....
West End Consol.	N. Y. Curb	1 7/16	1 3/16	1⅜	Mar. '23, Q	0.05
SILVER-LEAD						
Caledonia Mng.	N. Y. Curb	...	...	*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*31	*30½	*30½	Dec. '20,	0.15
Chief Consol.	Boston Curb	4⅛	4⅛	4⅛	Feb. '23, Q	0.10
Columbus Rexall	Salt Lake	*28½	*21	*23½	Aug. '22,	0.03
Consol. M. & S.	Montreal	29	29	29	Oct. '20, Q	0.62½
Eagle & Blue Bell	Boston Curb	†3	†2	2⅜	Nov. '22, K	0.05
Federal M. & S.	New York	10⅛	10⅛	10⅛	Jan '09,	1.50
Federal M. & S. pfd.	New York	53⅛	52	52⅛	Mar '23, Q	1.75
Florence Silver	Spokane	*38	*38	*38	Apr. '19, Q,X	0.01½
Hecla Mining	N. Y. Curb	9⅛	8⅜	9⅛	Mar. '23,	0.25
Iron Blossom Con.	N. Y. Curb	*34	*32	*34	Apr. '22, Q	0.02½
Marsh Mines	N. Y. Curb	*15	*10	*14	June '21, I	0.02
Park City	Salt Lake	3.40	3.40	3.40	Jan. '23,	0.10
Park Utah	N. Y. Curb	4	3⅞	4	.....	....
Prince Consol.	Salt Lake	*9½	*8	*9	Nov. '17,	0.02½
Silversmith	Spokane	*46½	*45	*45	Oct. '22,	0.01
Simon Silver Lead	N. Y. Curb	*33	*31	*33	.....	....
Tamarack-Custer	Spokane	1.60	1.50	1.50	Jan. '21, K	0.04
Tintic Standard	Salt Lake	3.02½	2.95	2.97½	Dec. '22, Q,X	0.10
Utah-Apex	Boston	4⅛	4⅛	4⅛	Nov. '20, K	0.25
IRON						
Bethlehem Steel "B"	New York	70	67	67½	Jan. '23	0.25
Char. Iron	Detroit	...	...	2 1/16	.....	....
Char. Iron, pfd.	Detroit	3½	3½	3½	.....	....
Colorado Fuel & Iron	New York	30½	28½	29	May '21	0.75
Col. Fuel & Iron, pfd.	New York	...	...	102	Feb. '23 Q	2.00
Gt. North'n Iron Ore	New York	36	34½	35	Dec. '22	1.00
Inland Steel	N. Y. Curb	...	...	47½	Mar. '23	0.25
Mexabi Iron	N. Y. Curb	11⅛	10⅜	10⅜	.....	....
Replogle Steel	New York	29⅜	27⅞	27⅞	.....	....
Republic I. & S.	New York	66⅞	60⅝	61⅞	May '21	1.50
Republic I. S., pfd.	New York	96⅞	96	96½	Jan. '22	1.75
Sloss-Sheffield S. & I.	New York	57½	54	54	Feb. '21	1.50
U. S. Steel	New York	109⅞	106½	106½	Mar. '23, Q	1.25
U. S. Steel, pfd.	New York	119⅞	118⅛	119	Feb. '23	1.75
Virginia I. C. & C.	New York	63	63	63	Jan. '22	1.50
Virginia I.C.&C.,pfd.	New York	83	83	83	Jan '23	2.50
VANADIUM						
Vanadium Corp.	New York	44⅛	41½	41⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	72½	72½	72½	Oct. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	89	89	89	Oct. '22, Q	1.75
SULPHUR						
Freeport Texas	New York	20⅜	18⅛	18⅛	Nov. '19, Q	1.00
Texas Gulf	New York	63	61	61	Mar. '23, Q	1.25
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅛	3⅛	3⅛	.....	....
MINING, SMELTING AND REFINING						
Amer. Metal	New York	55⅛	53	53	Mar. '23, Q	0.75
Amer. Metal pfd.	New York	117	116	116	Mar. '23, Q	1.75
Amer. Sm. & Ref.	New York	67⅛	64⅛	64⅛	Mar. '21, Q	1.00
Amer. Sm.& Ref. pfd	New York	101⅛	100⅛	100⅛	Mar. '23 Q	1.75
U. S. Sm. R. & M.	New York	41½	40	40	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	45⅞	45½	45⅞	Jan. '23 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

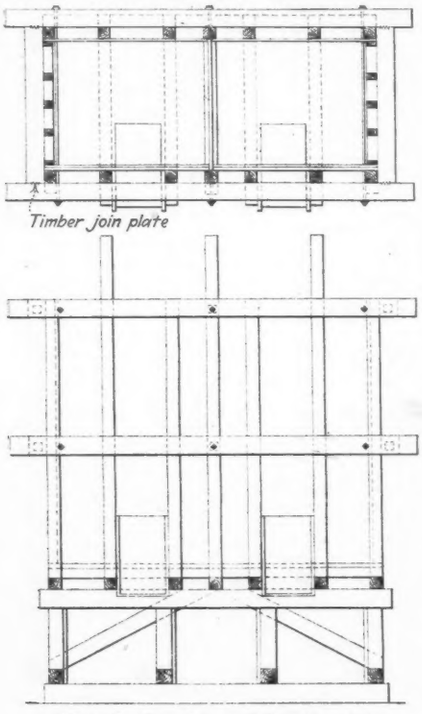
Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

NEW MACHINERY AND INVENTIONS

Timber Joint Plates

As a means of overcoming complicated, expensive and inefficient methods of joining timber construction, especially where stresses occur to any great extent, certain types of joint plates have been used to advantage. These should have an extended application in shaft timbering and other timber construction which is in general use about mines and mine and mill buildings.

For connecting wooden members, a practical device known as "Bulldog" timber joint plate is manufactured by the Midwest Steel & Supply Co., Inc., 28 West 44th St., New York. This device consists of a cold-rolled steel plate in which the metal is shaped and bent in such a way on the edges as to form a number of sharp teeth that bite in both directions. The effect, when the "Bulldogs" are placed between timbers is to secure rigidity and strength to the joints. They are made in 3-inch, 4-inch and 5-inch sizes. The metal is removed in the center of the plate so that bolts may be used. The accompanying sketch shows a suggestion for their use in connection with the construction of a bin.



Sketch showing application of timber joining plates

An Improvement in Centrifugal Pumps

The Evinrude Motor Co., Milwaukee, Wis., announces a recent improvement in the bearing equipment of its centrifugal pump. To support the pump shaft at the lower end, a ball thrust bearing has been provided. This bearing supplants the lignum vitae plug heretofore used. After a six months' test it has been found that the ball bearing greatly increases the life of the lower bearings and also makes the pump operate more freely and effectively. This improvement is of special value because it can be installed in those pumps now in the hands of users.

INDUSTRIAL NOTES

Colonial Steel Co., Pittsburgh, Pa., have just opened a new branch office and warehouse at Wallace, Idaho.

The Walter A. Zelnicker Supply Co. has moved from 325 Locust St. to new offices, Chamber of Commerce Building, 511 Locust St., St. Louis, Mo. The building in which the company were formerly located has been bought and will be used entirely by the Globe-Wernicke Co.

Richard S. Rubincam has been appointed manager of the Denver branch of the Mine & Smelter Supply Co., effective April 1, to succeed S. M. L. McSpadden. Mr. Rubincam has been in the employ of the company eighteen years.

A Handbook of Rock Drill Steel

Under the above title the Sullivan Machinery Co., Chicago, Ill., have published an 80-page booklet which deals, in a complete manner, with the selection, heating, forging and tempering of rock drill steel. Instructions for the care and use of Sullivan drill sharpeners and drill steel furnaces are also included. There are a number of illustrations-photographs and section drawings.

The convenient size, the general arrangement and the usability of the data will have a particular appeal to those who come in actual contact with drill steel handling and treatment. Certain descriptions of machines and devices have already appeared in these columns and in other publications but their collection under one cover and dealing with one general subject as they do, make the handbook of considerable interest and value. The "Drill Steel Don'ts" and "Be Sure" are most pertinent to the subject and should be carefully read by all mine blacksmiths at least. The handbook is designated as a circular No. 72-G.

Multi-Speed Motors—The Louis Allis Co., of Milwaukee, Wis., has issued a 12-p. bulletin on the Watson multi-speed motor which operates on polyphase alternating current circuits with approximately the close control of varying speeds afforded by direct current motors having adjustable speed through field control. The motor is particularly applicable to lathes, pipe-threading machines, punch presses, and other machine-shop equipment.

TRADE CATALOGS

Flexible Tubing—E. I. du Pont de Nemours & Co., Wilmington, Del., has issued a folder containing charts giving valuable data for mining engineers or flexible tubing for ventilation purposes. The tables, charts, and resistance data are based on the best reports obtainable. The charts are available on request to the company.

Iron Ore Analyses—Clement K. Quinn & Co., Duluth, Minn., and Cleveland, Ohio, have recently issued a 52-p. booklet giving their analyses of iron and manganiferous-iron ores for the season of 1923. These include ores from the Marquette, Menominee, Mesabi and Cuyuna iron ranges. This company, in addition to mining and marketing ores from its own properties, also acts as sales agents for "Mesabi sinter," a high-grade sintered magnetite produced by the Mesabi Iron Co.

Smelting Furnaces—The Mace Co., 514 18th St., Denver, Colo., has issued a 12-p. booklet which describes and outlines the operation of the Mace smelting furnace, which has been developed through several years of experimental work under actual operating conditions, and in its present form is said to be a proved success. It is a blast furnace with mechanical improvements, which make it practicable to operate in small units. The main variations from a standard lead or copper blast furnace are: Diametrically opposed rectangular tuyères in place of circular tuyères at regular intervals; a removable crucible, and an arrangement for keeping the crucible hot.

Motor Drives—A brief treatment of the development of ice-making machines, with suggestions as to the trend of progress, is given in bulletin No. 41,316 "Synchronous Motor Drive for Ammonia Compressors," recently prepared by the General Electric Co. From 1913 to 1920 the annual kilowatt-hour consumption of ice and refrigerating plants, in Chicago alone, has been increased from eight and one-half to nearly fifty-two million kilowatt-hours. A share of this increase is attributable largely to the use of slow-speed synchronous motors. Ice plants are almost always electrified with slow-speed synchronous motors, which means a power factor of unity or leading. After a thorough investigation of the demand and of the requirements for such a motor, the General Electric Co. has prepared a special line of 50 deg. motors, for the necessarily slow-speed operation of two-cylinder double-acting ammonia compressors. The horsepower rating of these motors is calculated so that it shall equal the maximum power required under the worst operating conditions. The bulletin lists a method of analysis for conversion of a distilled-water ice plant to an electrically-driven "raw-water" plant.